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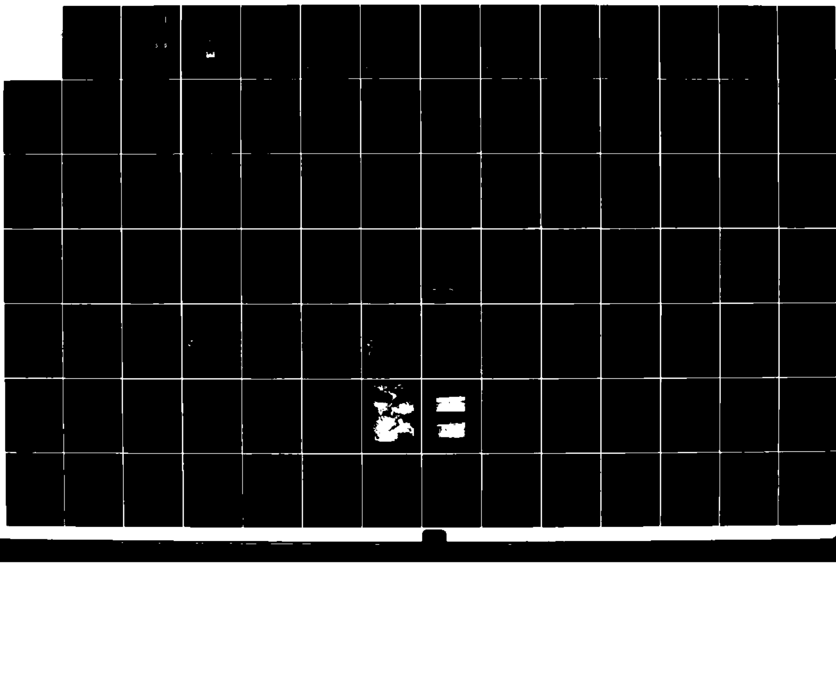

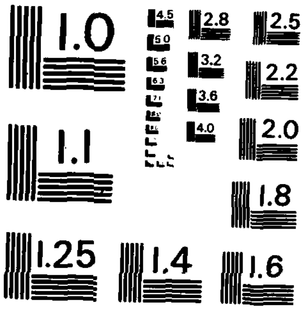

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SMALL NAVIGATION PROJECT

WEYMOUTH FORE RIVER
WEYMOUTH BRAINTREE
MASSACHUSETTS

DETAILED PROJECT REPORT AND ENVIRONMENTAL ASSESSMENT

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

FEBRUARY 1981

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The results of this study indicate that the most feasible plan of navigation improvement entails dredging a channel, 8,000 feet long and 6 feet deep at MLW. Proposed that dredged material be disposed of at sea at the "Boston Foul Area." No major detrimental impacts are forseen as the result of either the proposed plan of improvement or the disposal of dredge material. Maintenance of the channel will be required every 20 years.

SYLLABUS

This report represents a detailed engineering, economic, and environmental study to determine the need and justification for and impacts of a Federal Navigation Improvement Project at Weymouth Fore River, Braintree-Weymouth, Massachusetts. Local interests requested this study in an attempt to obtain Federal assistance in constructing a project that would assure safe navigation to the existing facilities along the upper reaches of the river from the existing Federal channel in Quincy. Information from field investigations and other sources was compiled to identify problems and needs of the area and develop alternative solutions. These alternatives have been analyzed in detail in order to find a plan of improvement that is responsive to both the National objectives and local needs.

The results of this study indicate that the most feasible plan of improvement entails dredging a channel, 8,000 feet long and 6 feet deep at MLW. The width would vary from 100 feet at the main ship channel to 60 feet at the Quincy Avenue Bridge. It is proposed that the dredged material be disposed of at sea at the "Boston Foul Area". No major detrimental impacts are foreseen as the result of either the proposed plan of improvement or the disposal of dredge material.

Based on current waterway use, the selected plan is economically justified. Total cost would be approximately $400,000, to be shared equally by non-Federal and Federal interests. Annual benefits of $362,100, when compared to annual costs of $46,300, yield a benefit-cost ratio of 7.8:1 for the selected plan. The Federal Government will be responsible for preparation of plans and specifications for construction.

After the initial construction, maintenance of the channel would be the responsibility of the Federal Government, contingent upon continued justification, availability of maintenance funds, and environmental acceptability of subsequent maintenance dredging. It is expected that maintenance of the channel will be required every 20 years.

WEYMOUTH FORE RIVER, WEYMOUTH-BRAINTREE, MASSACHUSETTS

DETAILED PROJECT REPORT

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INTRODUCTION

Boating interest in the northeast is continually increasing, at the rate of 6 percent per year, creating the need for more suitable boating facilities. The upper reaches of the Fore River provide a useful recreational boating area, but, in recent years, silting in the channel has caused a decline in the size of vessels utilizing the area.

This report is an economic, and environmental study of possible channel improvements requested by local interests in an attempt to restore the Weymouth Fore River to a condition of full navigability for recreational vessels in order that facilities on the river may respond to growing regional boating demand.

STUDY AUTHORITY

This detailed engineering and economic study was made to determine the need and justification for a Federal Navigation Improvement Project at Weymouth Fore River, Weymouth-Braintree, Massachusetts at the request of the town of Braintree. The authority for this project is derived from Section 107 of the 1960 River and Harbor Act, Public Law 86-645, as amended.

SCOPE OF STUDY

The scope of this study includes performance of a Comprehensive Water Resources Improvement Study and preparation of a Detailed Project Report consisting of:

1. Determining the navigational needs of the study area.

2. Formulating alternative channel improvement plans in light of national objectives and local needs.

3. Evaluating the economic, social and environmental impacts of the alternative plans.

4. Recommending channel improvements that are economically feasible, socially beneficial and environmentally acceptable.

Geographically, the scope of the study is limited to that section of the Weymouth Fore River, extending from the existing Federal ship channel to a point 600 feet upstream of the Quincy Avenue Bridge (Plate 1). In preparing this Detailed Project Report, immediate and future recreational boating needs for navigation improvements were investigated on both a local and a regional basis.

Pertinent study parameters include environmental, economic, social and recreational considerations, channel design, quantity and cost estimates, as well as selection of the most feasible plan of improvement.

STUDY PARTICIPANTS AND COORDINATION

The study and implementation of channel improvements at Weymouth Fore River necessitated close coordination between the Corps of Engineers, Federal, State and municipal agencies, as well as local associations and interest groups. In 1977, a reconnaissance study was done based on information presented by local officials. Appendix 3 contains a complete list of agencies coordinated with and summaries of meetings and workshops held during the study.

STUDIES OF OTHERS

Other than the reconnaissance report made by the New England Division, U.S. Army Corps of Engineers, there have been no prior reports prepared by the Government for this section of the Weymouth Fore River. Previous dredging was performed in 1956 by the Commonwealth of Massachusetts.

THE REPORT AND STUDY PROCESS

The initial steps in the study process includes a comprehensive inventory of available information, performance of topographic and hydrographic surveys, and preparation of base plans. As indicated under Public Views, extensive efforts were expended to contact public officials and interested parties to provide information and to seek public input into the study process. Based upon available information, baseline conditions were determined to formulate planning objectives and constraints. Preliminary improvement plans were developed and evaluated. These were presented to local public officials and interested groups. Based on comments received, certain alternative plans were selected for more detailed study.

This Detailed Project Report consists of a Main Report, supporting appendices, and an Environmental Assessment. The body of the Main Report is structured in accordance with the planning process followed during the course of the study. It is organized as follows: Problem Identification, Formulation of Preliminary Plans, Assessment and Evaluation of Detailed Plans, and Comparison of Detailed Plans.

The report has six appendices: Appendix 1, Problem Identification, supplements the material in the first two sections of this report. Appendix 2 addresses the formulation, assessment, and evaluation of alternative plans. Appendix 3 summarizes public views and responses. Appendix 4 contains supporting engineering data and analyses. Appendix 5 reviews economic, social, and cultural resources as well as benefit-cost studies. Appendix 6 evaluates the feasibility of alternative plans for disposal of dredged material.

PROBLEM IDENTIFICATION

The prime function of this section, as the title implies, is to identify the problems and needs of the study area in an attempt to delineate management measures that will address those problems and fulfill the needs identified. This is done by ascertaining the existing conditions, making an informed prediction of future conditions without Federal assistance, interviewing local interests in the study area, and using this information to identify areas of concern that must be addressed in the planning process. Efforts are then made to identify any physical conditions, laws, policies, or any other considerations that may constrain implementation of certain resource management measures. Through this knowledge of local needs and opportunities and any constraints that may be identified, the planning process can be directed toward the fulfillment of specific planning objectives formulated with this information and national objectives in mind.

NATIONAL OBJECTIVES

Planning for channel improvements in the Weymouth Fore River is based on the National Objectives of National Economic Development (NED) and enhancement of Environmental Objectives (EQ) as set forth in the 1973 by the National Water Resources Council in Principles and Standards for Planning Water and Related Land Resources. The purpose of the Principles and Standards is to promote the quality of life by planning for the attainment of the following national objectives.

NED Objective -

To enhance national economic development by increasing the value of the nation's output of goods and services and by improving national economic efficiency.

EQ Objective -

To enhance the quality of the environment by the management, conservation, preservation, creation, restoration or improvement of certain natural resources, cultural resources and ecological systems.

EXISTING CONDITIONS OF THE STUDY AREA

This section is intended to present information that will provide an understanding and appreciation of the existing environment, the natural and human resources of the study area and the area's development and economy. Accordingly, the purpose of this section is to provide a frame of reference against which to consider and evaluate the alternative plans for providing small boat navigation improvements.

The Fore River is a tidal estuary formed by two streams. These are the Monatiquot River, which enters upstream of the Quincy Avenue Bridge, and Smelt Brook, which flows into the channel approximately 500 feet seaward of Quincy Avenue along the South Shore. (See Plate 1, for the location and a graphic representation of the project area.)

The total length of the project area is approximately 9,000 feet. At present, the controlling depths in the channel range from two feet at MLW to 11 feet at MLW. The width varies from 13 feet to 100 feet. The average depth is less than five feet at MLW and the average width is 80 feet MLW. The mean tidal range is 9.5 feet with a spring tidal range of 11.5 feet.

The Fore River is approximately nine miles from Boston. The surrounding land area is highly developed, with a variety of uses, including recreational, commercial, and residential uses. Much of this land area is filled marshland but areas of private beach, salt marsh, and tidal flats still exist.

Marine life abundance and diversity in Weymouth Fore River is typical of an estuarine environment. The Mill Cove tidal flat was once noted for its clam beds. These clam beds have been severely damaged by silt and pollutants.

As noted in the Massachusetts Coastal Zone Management's Coastal Resources Atlas, the river is an anadromous fish run. Anadromous fish are those that live in salt water most of their life but spawn in fresh water. A complete list of flora and fauna is included in the environmental assessment.

Based on 1970 census statistics, the town of Braintree has an estimated population of 35,050 residents within a 13.70 square mile area. The median age of Braintree residents is 31 years with a median income of $13,030. The per capita income of the town is $3,599 and, of the persons over 16 years of age, 14,791 or 63 percent were employed.

The town of Weymouth has an estimated population of 54,610 within 16.70 square miles. The median age of Weymouth residents is 28 years with a median income of $11,631. Of the persons over 16 years of age, 23,084 or 63.6 percent were employed.

Route 53, the Quincy Avenue Bridge crosses the waterway at the upstream portion of the study area. The bridge has a horizontal clearance of 50 feet and a vertical clearance of 11.9 feet at MHW. The bridge is a fixed span and due to the limited horizontal and vertical clearances, potential boat traffic is restricted.

Boating usage consists of trips through the study area from moorings in the upstream section of the river to the main harbor areas and returning. Approximately 1200 manhours per week are spent boating in the study area, based on an estimate of 600 boats making two round trips per week with an average of one hour per trip.

Fishing usage varies widely and is based on tides, weather, and catches. A variety of species are caught, including smelt and eels, by a number of fishermen from both boat and shore. A major portion of these fishermen are neighborhood residents, particularly children. Clamming, while not extensive due to pollution, is undertaken by families and individuals to satisfy their personal needs. A rough estimate of the manhours expended on these activities is 100 manhours per week, an amount heavily influenced by the presence of school age children during the summer vacation period.

Swimming beaches, located along both shores experience heavy usage during summer months. The users are mainly local residents, particularly mothers and young children, with other town residents and visitors occasionally using the facilities. Smith's Beach is patrolled by life-guards during July and August. Swimming lessons given at Smith's beach influence the high estimate of seasonal usage to 2,000 man-hours per week.

CONDITION IF NO FEDERAL ACTION TAKEN

If no action is taken, siltation will continue in the channel and surrounding tidal flats. This will have a detrimental effect upon the economic growth and environmental quality of the area.

In recent years, the two yacht clubs located on the Fore River have experienced a steadily increasing memberships however, many of these members are non-boat owners. The size of vessels utilizing yacht club facilities have decreased due to the lack of available channel depth.

Due to its proximity to Boston Harbor and the rapdily expanding boating population, the Braintree-Weymouth area has been unable to meet the demands for mooring and docking facilities. The existing needs of the boating community can best be met with improved channel conditions.

Environmentally, the area has experienced a decrease in tidal flushing due to the silting condition. Dredging could increase the flushing of the system, remove pollutants, and increase biological productivity in the area.

PROBLEMS, NEEDS, AND OPPORTUNITIES

Problems

Many of the boats that now use Weymouth Fore River are restricted to high tide because the channel is not deep enough for all weather and tidal conditions. The depths within the channel are very shallow (2' MLW) and, in places, the channel narrows to less than 13 feet. Some existing boats moor in or near the channel thereby making it difficult and hazardous for other boats to use the channel. In order to avoid collisions with other craft, vessels traversing the channel run aground causing propeller and shaft damage or, suck mud into their cooling systems by maneuvering too close to the channel edges causing fouling. The shoaling conditions have

also reduced the environmental quality and nonboating recreational use of the river.

Recreational boating has increased in the greater Boston area at a rapid rate. A rapid increase in the number of recreational boat owners has caused an increase demand on moorings and marinas. Presently the deamnd is 62 percent greater than the supply. This demand coupled with environmental regulation, coastal zone policies, and economic considerations has dictated that all existing facilities must obtain maximum utilization.

Because of the extensive shoaling in the river vessels will be forced to leave the river if this shoaling continues. This will further over tax other facilities in the region.

Three drainage outfalls along both shorelines have been silted in by the shoaling. This has meant the flooding of property within their particular watershed areas, causing damage and inconvenience. During the winter of 1978, flooding was particularly prevalent in the small residential area along the Weymouth shore, about 2,000 feet downstream of the Quincy Avenue Bridge.

The silting in of the Braintree Light Department's power plants cooling water intakes and the damaging of the clam beds by the covering of Mill Cove tidal flat are additional effects of the shoaling.

Needs

The need of the Weymouth-Fore River is, therefore, maximum utilization of existing recreational boating facilities.

It should be noted that several of the problems along the river do not pertain to navigation. Due to the scope of the study only solutions to the navigation problems are addressed. However, none of the potential solutions will have an adverse impact on the other problems within the river.

Opportunities

There is presently a unique opportunity to assist local interests and State government in these attempt to address the shoaling problems in the river which hinder navigation in order to maximize utilization of existing facilities. Improvements will afford users of the Fore River the opportunity to maximize their utilization of Boston Harbor's natural resources.

PLANNING CONSTRAINTS

Planning constraints are those parameters which can place limitations on any proposed plan of improvement. As limitations, they are used to direct plan formulation and restrict impacts cutting across a broad spectrum of concerns. These concerns may include natural conditions within the project site, technological states of the art, economic limits, and legal restrictions.

This study has identified five major concerns which may be identified as contraints. They are:

1. Due to the recreational nature of this project, local costs must be kept within the local's ability to pay.

2. Because the river is an anadromous fish run, construction must occur only during the fall months.

3. Construction must be accomplished based on a maximum a 16-hour day to minimize the noise in this residential area.

4. Salt marsh and tidal flats in the study area should be preserved.

5. Since the Quincy Street Bridge is a fixed span bridge with a clearance of 11.9 feet at MHW (21.4 at MLW) the size and type of vessel that can navigate above the bridge is limited.

A detailed discussion of planning constraints is included in Appendix 1.

PLANNING OBJECTIVES

Planning objectives for this study were established after carefully analyzing the identified concerns regarding the use of water and related land resources in this study area. The purpose of these planning objectives is to translate identified problems, needs, and opportunities, into specific objectives for the study. Planning objectives, as set forth herein, will be used in conjunction with planning constraints in the development of alternate plans that properly address study objectives and area needs. The establishment of clearly defined planning objectives is also essential in evaluating the various plans that have been studied. The relative merit of each plan is determined, in great part, by the degree to which it addresses and fulfills each planning objective.

Based on the discussions of problems, needs, and opportunities previously presented, two planning objectives have been identified as important guidelines to formulation and evaluation of plans to meet the ara needs and study objectives.

- Contribute to the safety of navigation for recreational vessels in the Weymouth Fore River during the 1980-2030 period of analysis.

- Contribute to the full utilization of existing recreational boating facilities and recreational vessels in the Weymouth Fore River, during the 1980-2030 period of analysis.

FORMULATION OF PRELIMINARY PLANS

Systematic consideration of the problems, needs, and opportunities led to the identification of resource management measures that address these problems and needs. Applicable management measures were then combined in an attempt to formulate alternative preliminary plans. These plans, designed to achieve the planning objectives stated previously, were developed in light of the planning constraints. State and local objectives were also paramount considerations in the formulation of alternative plans.

MANAGEMENT MEASURES

As the basis for formulating alternative plans, a broad range of management measures can be identified to address the planning objectives. Management measures can generally be categorized as either structural or non-structural.

Structural measures would generally involve variations of dredging the Weymouth Fore River to provide access to the existing facilities. Non-structural measures would principally involve the determination of achieving planning objectives by other means at lower costs.

Due to the constraints, concerns, and objectives placed on the project, there are no feasible means to accomplish the project goals by implementation of non-structural measures. A more complete discussion of nonstructural measures is presented in Appendix 2.

Non-structural measures would involve such things relocation of the vessels and/or the facilities or the use of navigation aids and traffic controls. Relocation of the vessels to other regional facilities is incompatible with the regional needs of more facilities and local needs of providing adequate access to existing viable marinas. Relocations of the facilities is an expensive proposition incompatible with local economic needs and regional coastal management issues. No navigation aids can properly address the navigation needs of the study area.

PLAN FORMULATION RATIONALE

The formulation of possible plans of improvement for the Weymouth Fore River is predicated on a set of criteria adopted to permit the development and selection of a plan which responds to area problems and needs. Therefore, the first step in formulation of alternative plans was to take note of identified needs and objectives of all concerned groups. In light of this information identified constraints, and planning objectives, formulation criteria were identified. These criteria are grouped in four principle categories: technical, economic, environmental, and social/-cultural. Technical criteria principally involves the design of a channel that provides a safe and adequate entrance channel that minimizes dredging

costs. Economic criteria are directed toward the attainment of maximizing net benefits while keeping local costs within local ability to pay. Environmental criteria attempt to direct formulation to minimize use of resources for project implementation, minimize impacts, and, if possible, enhance the environment. Social and cultural criteria are established in an attempt to assist in achievement of community goals without damaging any valuable cultural resources. Detailed formulation criteria are presented in Appendix 2.

In the formulation of plans, two factors have an influence on all formulated plans. One important general consideration was the development of sufficient channel dimensions. The first step involved an attempt to identify the number, type, and size of boats using the Weymouth-Fore River. These characteristics are needed to establish channel configurations that would provide for safe navigation and to properly assess benefits that would be generated by project improvements. As well as an assessment of the existing fleet, regional and national trends in boat sales and design were used. From these facts a minimum depth of six feet at MLW, and a minimum width of 60 feet were chosen. Appendix 4 details channel design considerations.

The disposal of the dredged material was also an important general consideration. Four major considerations have been investigated:

- Marsh and wetland areas adjacent to the river.
- Inland disposal.
- Marsh creation.
- Offshore ocean dumping.

In assessing the dredge disposal concepts, each has a different impact. The disposal of dredged material is discussed in detail in Appendix 6.

The filling of marsh and wetland areas would have long-term destructive effects on plant and shellfish communities in these areas. This action is contradictory by State and local regulations and the planning constraints therefore it is unacceptable.

Inland disposal sites can be considered, depending on the quantity and content of the dredged material. Polluted material would have an adverse environmental impact. Availability of convenient land areas as well as transportation and handling of the material may add to the project cost. This option is also considered unacceptable due to dirt and noise pollution associated with overland trucking of the material to the disposal site as near shore upland sites do not exist and all considered sites were beyond normal hydraulic pumping system capability.

Marsh creation requires a large amount of land area which is inundated by the tides. As no suitable land area is available, this option is not considered feasible for further consideration.

The only available ocean disposal site within the local area is known as the Boston "Foul Area". Planning has proceeded using this location.

ANALYSIS OF PLANS CONSIDERED IN PRELIMINARY PLANNING

Utilizing the formulation criteria and general considerations outlined above, three alternative plans were formulated that will, to varying degrees, respond to area needs.

DESCRIPTION OF PLANS

Plan A would provide an 8,000-foot channel 6 feet deep at MLW. The width would vary from 100 feet at the main ship channel to 60 feet at the Quincy Avenue Bridge.

Plan B is similar to Plan A except that the channel would continue 600 feet upstream of the Quincy Avenue Bridge at a width of 60 feet and a depth of 6 ft at MLW.

Plan C contains the channel design elements in Plan A plus two anchorage areas with a combined total area of eight acres. Based on the method of mooring commonly referred to as free swinging, 57 vessels could safely utilize the anticipated anchorage area. It is conceivable that the number of vessels mooring in these two areas could be substantially increased should more efficient methods be used. Normal procedure, however, calls for the more conservative assumption of free swing mooring.

Other alternatives were considered in the preliminary planning stages. Various combinations of anchorages two acres, four acres and six acres were analyzed. All anchorage schemes were found to not be incrementally justified. Furthermore, smaller anchorages would involve placement in areas where either tidal flats and saltmarsh would be destroyed or a conflict with swimmers would arise.

Anchorage areas could constitute an important improvement in the area and possibly aid in reducing the overcrowded regional conditions. For this reason criteria for developing anchorage area along the river were identified and several anchorage scheme analysed in the preliminary planning stages.

The criteria for developing new anchorage areas was:

1- new anchorage areas must be in reasonably close proximity to existing shorebase facilities so that either owners can row small boat out to the area or a launch service can be provided.

2 - Anchorage areas should not adversely impact valuable intertidal areas.

3 - If intertidal areas are impacted the anchorage should provide some measurable relief to the regional overcrowding problems.

4 - Anchorage areas should be economically justified.

5 - Any anchorage area along the river should be at least 70 feet wide.

Four anchorage schemes, 2 acres, 4 acres, 6 acres and 8 acres were evaluated against the anchorage planning criteria.

In order to meet the first criteria of close proximity to shorebase facilities the anchorage areas must be located upstream of the Metropolitan Yacht Club. If they are located downstream there will be small row boats using the middle station of the channel to get to the anchorages. However, if the anchorages are upstream of the Metropolitan Yacht Club. They will impact intertidal areas.

In looking at the number of boat per acre of anchorage a two acre anchorage would hold approximately 14 boats average length of 25 feet. While the 8 acres of anchorage would hold 57 boats of 25 feet. This presumes the method of mooring known as free swing. Since any anchorage will impact some intertidal area there should be sufficient need in terms of reducing regional demand, in order to trade-off these valuable areas. With approximately 16,000 boats in the greater Boston area a 2 acre anchorage would provide moorings for .09 percent of the fleet. An 8 acre anchorage would provide moorings for .4 percent of the fleet. This means that any trade-off between anchorages and intertidal areas will benefit less than one percent of the fleet.

In terms of incremental analysis none of the anchorages is justified without the channel, however eight acres of anchorage is almost justified.

Because of the need, even though there would be extensive trade-offs involved, one anchorage scheme was developed into a plan and carried forth for detailed study. Plan C, eight acres of anchorage was considered the most likely anchorage scheme and was therefore chosen to be carried through.

COMPARATIVE ASSESSMENT AND EVALUATION OF THE PRELIMINARY ALTERNATIVE PLANS

The preliminary plans were evaluated with respect to national objectives, planning objectives, and planning constraints.

The width and depth of the channel in Plans A, B and C reflect the needs of the existing boating fleet.

The minimum length (to the Quincy Avenue Bridge) was deemed necessary to provide adequate access for boats approaching the Braintree Yacht Club, and public launching ramp.

The difference between Plans A and B is a length of 600 feet, upstream of the Quincy Avenue Bridge. The bridge is a fixed structure 50 feet wide with an 11.9 foot clearance at MLW. Even though the height of the bridge is quite low, both plans were initially considered feasible, economically and environmentally. Because mooring facilities in the study area are limited, additional anchorage area provided by Plan C could be desirable.

CONCLUSION

As indicated in Table 2 System of Accounts, all plans of improvement are economically justified and to some extent address the problems, needs and objectives. Detailed analysis is therefore required for all plans.

ASSESSMENT AND EVALUATION OF DETAILED PLANS

This section contains an analysis of the three improvement alternatives selected for detailed study. Evaluation of the alternatives is based on their relative attainment of the project planning and national objectives.

GENERAL ASSESSMENT AND EVALUATION OF IMPACTS

The general impacts of the proposed project which are common to all three alternatives are evaluated below. Impacts which are unique to each alternative are assessed and evaluated in subsequent sections of this report.

DREDGING IMPACTS - Dredging operations cause both short-term and long-term impacts including temporary air, noise and water pollution. The most serious impact is the effects of increased turbidity on shellfish and finfish. For these reasons, dredging of the Weymouth-Fore River will be scheduled to take place in the fall, and thereby avoid adverse effects on the anadromous fish in the river.

Long-term impacts of dredging include removal of existing benthic organisms from the river bottom, and alteration of marine habits on the river bottom.

Any long-term impacts on the marine organisms will be mitigated by natural repopulation of the area disturbed by dredging.

The amount of dredging required ranges from 31,000 cubic yards for Plan A to 170,000 cubic yards for Plan C.

SHORELINE IMPACTS - None of the three alternative plans will impact the Weymouth or Braintree shoreline.

ECONOMIC IMPACTS - Economic impacts of the proposed alternatives have been evaluated by determining the estimated costs and benefits. The cost estimates are based upon consideration of numerous factors including the quantities of dredge material, mobilization and demobilization, equipment costs and wage rates, anticipated dredging rates in cubic yards per hour, engineering, supervision, administration and contingencies.

Equivalent annual costs have been calculated for the purpose of the benefit-cost analysis. These costs have been determined using the 1981 rate of 7-3/8 percent.

Benefits for the three alternatives have been calculated on the number of vessels expected to use the area with the implementation of the alternative. Calculations of the projects benefits are based on the total number of vessels using and expected to use the water. A monetary amount is calculated based on the profit the owner would see if he hired his boat out. Because the benefits attributable to the project are based on tidal delays, the monetary amount is the difference between existing usage (approximately 60 percent utilization) and future usage (approximately 90 or 100 percent utilization). The methods and assumptions used to calculate benefits to the fleet and detailed benefit-cost calculations are contained in Appendix 5.

MITIGATION REQUIREMENTS

Different social and environmental considerations dictate that dredging occur only between September and late November. The area has been identified by the Massachusetts Coastal Zone Management program as an anadromous fish run. Anadromous fish are those which live in saltwater but spawn in fresh water during the spring (March to June). Dredging during this period would destroy the larvae and young fish.

Dredging during the summer months would cause disruption and become a potential hazard to boating traffic and recreational swimmers. Due to noise pollution, problems attendant to dredging operations work will be limited to 16 hours per day, five days per week.

IMPLEMENTATION RESPONSIBILITIES

This section is to detail the non-Federal responsibilities and cost apportionment associated with the project.

Cost Allocation - One hundred percent of the cost of the project is allocated to the recreational channel. There are no other components in the Federal project.

Cost Apportionment

Due to the recreational nature of the project benefits, non-Federal interests will be required to pay 50 percent of the first cost of construction. Federal interests will be responsible for the remaining 50 percent of the first cost of construction.

Federal Responsibilities

When approved and funded, Federal responsibilities under this plan include 50 percent of the first cost of construction, the preparation of contract plans and specifications, the supervision of the dredging of the main channel, and the installation of aids to navigation. After construction, the Federal Government will maintain the dredged areas as required.

Non-Federal Responsibilities

The responsibilities of non-Federal interests associated with the selected plan of improvement include the following items of local cooperation, which must be agreed upon prior to project implementation:

- Contribute 50 percent of the cost of construction of the selected plan of improvement.

- Provide, without cost to the United States, all lands, easements, and rights-of-way necessary for the construction and subsequent maintenance of the Federal channel, and land and necessary dikes and weirs for disposal of dredged material or the costs of such retaining works.

- Provide, maintain, and operate, without cost to the United States, an adequate public landing with provisions for the sale of motor fuel, lubricants and potable water, open and available to the use of all on equal terms.

- Hold and save the United States free from damages that may result from construction and maintenance of the project except damages resulting from our contractors negligence.

- Accomplish, without cost to the United States, alterations and relocations as required in sewer, water supply, drainage and other utility facilities.

- Provide and maintain berths, floats, piers, and similar marina and mooring facilities as needed for transient and local vessels as well as necessary access roads, parking areas, and other needed public use shore facilities, open and available to all on equal terms.

- Assume full responsibility for all project costs in excess of the Federal cost limitation of $2 million dollars.

• Establish regulations prohibiting discharge of untreated sewage, garbage, and other pollutants in the waters of the harbor by users thereof. These regulations shall be in accordance with applicable laws or regulations of Federal, State and local authorities responsible for pollution prevention and control.

The following sections of this report consist of an assessment and evaluation of impacts which are specific to the individual alternative plans.

PLAN A

PLAN DESCRIPTION

The following section evaluates Plan A based on its social, environmental, and economic justification and impacts.

Plan A is to dredge the channel from the main ship channel to the Quincy Avenue Bridge as shown on Plate 2. This plan provides for an 8,000-foot long channel as follows:

- Section 1 with a width of 100 feet at MLW and a depth of six feet MLW, beginning where the present 35-foot channel ends, and extending upstream 2,500 feet to the eastern end of Idlewell.

- Section 2 with a width of 75 feet at a depth of six feet MLW. This portion will begin where the 100-foot width ends and extend upstream for approximately 3,000 feet to the site of Watson Park.

- Section 3 with a width of 60 feet at a MLW depth of six feet. This portion begins where the 75-foot width ends and extends upstream for approximately 2,500 feet to the Quincy Avenue Bridge.

This entails dredging approximately 31,000 cubic yards of material. The dredge disposal would be at the Boston "Foul Area" 29N miles from the river.

IMPACT ASSESSMENT

DREDGING IMPACTS - Plan A requires that 31,000 cubic yards of material be dredged. None of this dredging would be within the intertidal area (that area between high and low tide).

SHORELINE IMPACTS - Plan A does not result in any shoreline changes.

IMPACTS ON NAVIGATION - Plan A would provide for fuller utilization of vessels presently on the river. At this time vessels are only able to utilize the river 55 to 60 percent of the time. Plan A would allow 95 to 100 percent utilization of the area.

The widths of Plan A reflect the needs of the existing fleet. Given the maneuverability of the average boats utilizing the river and the average expertise of the user 60 feet in width is the minimum acceptable for safety. As the channel moves downstream towards the main ship channel the number of craft utilizing the channel at any one time increases. This increase is due to the location of the yacht clubs and boat ramps along the river. Therefore, the channel is widened as it progresses downstream to safely accommodate the increased traffic.

ECONOMIC IMPACTS - Dredging disposal costs are based upon disposal at sea. The estimated first cost of Plan A is 400,000. The equivalent annual cost based on an interest rate of 7-3/8 percent is 46,800. The annual project benefit is estimated at 362,100.

Annual costs and benefits are shown below.

Annual Costs	Annual Benefits	B/C Ratio	Net Benefits
$46,300	$362,100	7.8:1	$316,000

EVALUATION AND TRADEOFF ANALYSIS

Plan A would maximize utilization of the existing boats while at the same time inolve the minimum amount of dredging. Plan A would have no long term adverse impact on the existing environmental conditions in the river and would result in no destruction of intertidal area.

COST APPORTIONMENT

The local share of the costs of the Federal project for Plan A is estimated at $200,000.

PUBLIC VIEWS

Views of Federal Agencies

On January 7, 1980, Federal agencies were sent copies of the public meeting announcement, and summaries of environmental and socio-economic concerns. Letter responses have been received from U.S. Fish & Wildlife, Environmental Protection Agency, and National Marine Fisheries. These letters are included in Appendix 3. The agencies expressed concern over the disposal of the material at the Boston Foul Area without bioaccumulation testing, subsequently bioaccumulation tests as outlined in U.S. Army Corps of Engineers-EPA guidelines were performed.

View of Non-Federal Agencies

At the public meeting held 7 February 1980, at which 120 persons were in attendance, several individuals voiced their pleasure at the results of the study. No opposition was voiced at the meeting and several letters from the local officials supporting the project are inclosed in Appendix 3. Responses from State agencies include several letters supporting the project from the Division of Land & Water Use.

PLAN B

PLAN DESCRIPTION

Plan B is the same channel as Plan A with the addition of a 600-foot extension upstream of the Quincy Avenue Bridge as shown on Plate 3.

Plan B entails dredging a channel from the main ship channel to the Quincy Avenue Bridge. This plan provides an 8,000-foot long channel as follows:

Section 1 - a channel with a width of 100 feet and a depth of six feet at MLW beginning where the present 35-foot ship channel ends, and extending upstream 2,500 feet to the eastern end of Idlewell.

Section 2 - a channel with a width of 80 feet and a depth of six feet at MLW. This portion will begin where the 100-foot width ends and extend upstream for approximately 3,000 feet to the site of Watson Park.

Section 3 - a channel with a width of 60 feet and a depth of 6 feet at MLW. This portion begins where the 80-foot width ends and extends up to the Quincy Avenue Bridge.

Section 4 - A channel with a width of 60 feet and a depth of 6 feet at MLW. The portion begins at the Quincy Avenue Bridge and continues upstream under the bridge for a distance of 600 feet.

IMPACT ASSESSMENT

DREDGING IMPACTS - Plan B requires the dredging of approximately 39,000 cubic yards. This plan does not involve the dredging of any intertidal areas.

SHORELINE IMPACTS - Plan B does not result in any changes to the existing shoreline.

NAVIGATION IMPACTS - Plan B would increase navigation in Sections 1, 2 and 3. In Section 4 it would also increase navigation but free navigation is impeded by the vertical clearance of the Quincy Avenue Bridge. The bridge is a fixed structure with a vertical clearance of 11.9 feet at MLW.

ECONOMIC IMPACTS - The initial cost of the Federal project for Plan B is $534,000. The equivalent annual cost is estimated at $61,500 at an interest rate of 7-3/8 percent. Project benefits are estimated at $362,100 annually.

Annual Cost	Annual Benefits	B/C Ratio	Net Benefits
61,500	362,100	5.8:1	300,600

EVALUATION AND TRADEOFF ANALYSIS

Construction of the extended channel can be accomplished with a relatively modest increment in the quantity of dredging required by Plan A. However, there is a substantial increased cost. This is due to the fact that dredging equipment would have to be mobilized and demobilized upstream for the last section. Furthermore, the vertical clearance under the bridge is too low - so barges couldn't move upstream enough to receive the material.

Benefits for Plan B would not increase substantially due to the clearance of the bridge. Most vessels needing six feet of water are taller than 11.9 feet in height.

COST APPORTIONMENT

Non-Federal interests would be responsible for payment of an estimated $267,000 which is 50 percent of the initial cost of the Federal project.

PUBLIC VIEWS

Views of Federal Agencies

Federal agencies were concerned over the increased dredging quantities associated with Plan B, even though it is a minimal amount.

Views of Non-Federal Agencies

Non-Federal agencies felt that due to the lack of increased benefits from Plan B that it was not necessary. Local interest expressed concern over increased noise and dirt associated with mobilizing and demobilizing the dredge over the bridge. Some concern was also expressed over potential impacts of dredging near the bridge on its stability.

PLAN C

PLAN DESCRIPTION

Plan C - contains the same channel design elements in Plan A plus two anchorage areas with a combined total area of 8 acres. The proposed location is shown on Plate 4. Anchorage area A, located on the south side of the channel, is approximately 4.6 acres and would accommodate approximately 33 vessels 25 feet in length. Anchorage area B is approximately 3.4 acres situated along the northern side of the river. This area would accommodate 24 vessels, 25 feet in length. The assumption of 57 vessels safely utilizing the anticipated anchorage area is based on the method of mooring commonly referred to as free swing.

IMPACT ASSESSMENT

DREDGING IMPACTS - Plan C requires that 170,000 c.y. of material be dredged. Of this amount approximately 6.5 acres would be dredged from the intertidal area.

SHORELINE IMPACTS - Dredging of the intertidal area could cause slumping of the banks adjacent to the proposed anchorages.

NAVIGATION IMPACTS - Plan C would increase the fleet utilizing the river by 57 vessels. This would have no impact on the 80-foot section of the channel or the 100-foot section of the channel. However, this might increase usage in the 60-foot wide section to a point where safe passage would be impaired.

ECONOMIC IMPACTS - The initial cost of the Federal project for Plan C is $2,024,500. The equivalent annual cost is estimated at $153,600 at an interest rate of 7-3/8 percent. Project benefits are estimated at $532,500 annually. Of the annual costs $30,300 are attributable to the channel in Plan C while $123,300 are attributed to the anchorage. The benefits attributable to the channel are $362,100 annually and $170,400 annually for the anchorage. The B/C ratio for Plan C is 2.2:1. However, an incremental analysis shows that the B/C ratio for the channel is 7.8:1, while the B/C ratio for the anchorage is 0.9:1.

EVALUATION AND TRADEOFF ANALYSIS

Plan C would increase the number of boats utilizing the river by 57. This number is three percent of the projected demand in the greater Boston area. Furthermore <u>incremental</u> analysis show that the anchorage areas are not justified. Plan C would have some irrevocable impacts on the intertidal area that would need to be dredged to provide these anchorages.

Due to the large quantities of material to be dredged Plan C would also involve a 2 phase dredging operation. The channel and one anchorage could be dredged in the small time frame allowed by the mitigation requirements. The other anchorage would have to wait a full year to be dredged.

COST APPORTIONMENT

The local share of the cost of the Federal project for Plan C is estimated at $1,012,250.

Public Views

Views of Federal Agencies

All Federal agencies felt that the destruction of salt marsh and shellfish beds for the anchorages was unacceptable.

Views of Non-Federal Agencies

State resource agencies also felt that destruction of the intertidal areas were unacceptable. Local officials and several members of the public felt that an increase in the size of the feet was not warranted.

COMPARISON OF DETAILED PLANS

In general, there is a tradeoff between maximum utilization of the existing facilities and fleet expansion. While all three plans have B/C ratios greater than one incremental analysis shows the anchorages in Plan C are marginal.

Plan A has the highest benefit/cost ratio, and net benefits (benefit minus costs). Plan C has the lowest net benefits.

The benefits for all three plans were based on the existing fleet composition of 80 percent power vessels 20 percent sail. However, trends in the recreational boating industry indicate that within the project life the composition of the fleet might change. Two scenarios for fleet composition were analyzed with respect to all three plans. A detailed analysis of these scenarios is given in Appendix 5. The results are summarized in Table 1. The two scenarios are 1) change in fleet composition to 50 percent sail, 50 percent power and 2) a change to composition to 100 percent sail.

Table 1

Plan A	Existing	Scenario 1	Scenario 2
B/C	7.8:1	5.0:1	3.0:1
Net	316,000	184,900	92,500
Annual	362,100	230,900	138,500
Plan B			
B/C	5.8:1	3.7:1	2.2:1
Net	300,600	169,500	77,000
Annual	362,100	230,900	138,500
Plan C			
B/C	2.2:1	1.2:1	0.7:1
Net	297,900	52,400	0
Annual	532,500	286,800	172,600
Plan C (Channel)			
B/C	7.8:1	5.0:1	3.0:1
Net	316,000	184,900	92,500
Annual	362,100	230,900	138,500
Plan C (Anchorage)			
B/C	0.9:1	0.2:1	0.0:1
Net	0	0	0
Annual	170,400	55,938	34,100

From this table it can be shown that if the composition of the fleet were to change Plan C is not completely justified and Plan A would have the largest net benefits.

Environmentally Plans A and B are similar and would have no adverse impact. Plan C would destroy several acres of intertidal areas along the river.

Navigation would be maximized by Plans A and B. Plan C would increase existing vessels and possibly cause congestion around the anchorage areas.

RATIONALE FOR DESIGNATION OF THE NED PLAN

Plan A has been designated as the NED plan based on the criteria of the highest net benefits.

RATIONALE FOR DESIGNATION OF THE EQ PLAN

The EQ plan is, by definition, that plan which contributes most to the enhancemenet of the quality of the environment by the management, conservation, preservation, creation, restoration, or improvemenet of the quality of certain natural and cultural resources and ecological systems. Since none of the plans discussed make positive contributions to the EQ account, there can be no EQ plan. Plan A is, however, the least damaging alternative since it minimized dredging.

RATIONALE FOR SELECTED PLAN

Plan A is recommended for implementation. It provides maximum net benefit, while its environmental impacts are minimal. Plan A is also the plan which best addresses the planning objectives and constraints.

CONCLUSIONS

As Division Engineer of the New England Division, Corps of Engineers, I have reviewed and evaluated in the overall public interest, all pertinent data concerning the proposed plan of improvement, as well as the stated views of other interested agencies and the concerned public relative to the various practical alternatives in providing navigation improvements in Weymouth-Fore River, Weymouth-Braintree, Massachusetts.

The possible consequence of alternatives have been studied according to engineering feasibility, environmental impacts, economic factors of regional and national resource development and other considerations of social well-being in the public interest. The ramifications of these issues have been stated in detail in the formulation of this plan of improvement and in other sections of this report.

In summary, there are substantial benefits to be derived by providing the recreational boaters in the Weymouth-Fore River with reliable access to the river at all stages of tide.

The following Table 1, System of Accounts, is a general analysis relevant to plan selection. It presents the determination factors that underlie each final alternative by displaying the significant beneficial and adverse impacts. This system is utilized for the purpose of tradeoff analysis and final decision making.

It is noted that the improvement would cause a minor disruption of the environment during dredging and disposal operations. However, as those impacts are not considered significant, an Environmental Assessment has been performed in lieu of an Environmental Impact Statement. Due to the significant benefits attributable to the recreational boating industry, it is considered that this minimum adverse environmental effect is offset by improvement and the overall economic growth of the region.

I find that the proposed action, as developed in this report, is based on a thorough analysis and evaluation of various practicable alternative courses of action for achieving the stated objective, that, wherever adverse effects are found to be involved, they cannot be avoided by following reasonable alternatives and still achieve the specified purposes; that where the proposed action has an adverse effect, this effect is either ameliorated or substantially outweighed by other considerations. The recommended action is consistent with national policy, statutes, and administrative directives, and should best serve the interests of the general public.

Table 2
SYSTEM OF ACCOUNTS
WEYMOUTH-FORE RIVER

A. PLAN DESCRIPTION	Without Project Condition	Plan A Channel 8000 Ft. long 6 ft. deep 60-100 ft. wide	Plan B Channel 8600 Ft. long 6 ft. deep 60-100 ft. wide	Plan C from Plan B plus 2 anchorage areas
B. IMPACT ASSESSMENT				
1. NED				
a. Annual Benefits	0	362,100	362,100	532,400
b. Annual Const. Cost	0	30,300	40,500	153,680
c. Annual Maint. Cost	0	16,000	21,000	80,900
d. B/C Ratio	0	7.8:1	5.8:1	2.2:1
e. Net Benefits	0	316,000	300,600	297,820
2. E.Q.				
a. Benthic Habitat Altered		1	2	3
b. Dredging Impacts on Water Quality		2	2	3
c. Effects on Shore-line wetlands		0	0	4
Project EQ Rank		(1)	(2)	(3)
3. SWB				
a. Safety for Recre-ational Vessels	4	2	2	2
Project SWB Rank		(1)	(2)	(3)
4. RD				
a. Employment and Growth	3	0	0	2
Project RD Rank		(1)	(2)	(3)
C. PLAN EVALUATION CONTRIBUTION TO PLANNING OBJECTIVES AND CRITERIA	W/O	A	B	C
a. Safety for boating recreational uses		Positive 4	Positive 4	Positive 2
b. Costs Acceptable to non-Federal interests		Positive 4	Positive 3	
c. Maximum utilization of existing facilities		Positive 3	Positive 3	Positive 2
D. IMPLEMENTATION RESPONSIBILITY				
a. Federal		200,000	267,000	1,012,250
b. Local		200,000	267,000	1,012,250

1=Minimum Adverse Impact
4=Maximum Adverse Impact
0=No Adverse Impact or Positive Impact

ENVIRONMENTAL ASSESSMENT

WEYMOUTH FORE RIVER

WEYMOUTH-BRAINTREE

MASSACHUSETTS

ENVIRONMENTAL ASSESSMENT

INTRODUCTION

In keeping with the National Environmental Policy Act of 1969, the New England Division, Army Corps of Engineers, has examined environmental values as part of the planning and development of the Proposed Action Plan. Background environmental information was compiled for proposal of this report through interviews with various State and local interest groups and a search of published literature. This report provides an assessment of environmental impacts and alternatives considered.

This report and assessment was prepared under the authority of Section 107 of the 1960 River and Harbor Act as amended.

The proposed project provides for construction of a navigable channel from the main ship channel at the Weymouth-Fore River extending 8,000 feet upstream to the Quincy Avenue Bridge (Plate 2). The channel would be divided into three sections. Section 1 would be 100 feet wide and six feet deep at MLW, Section 2 would be 80 feet wide and six feet deep at MLW, and Section 3 would be 60 feet wide and six feet deep at MLW. Approximately 31,000 cubic yards of silty-clay sediments would be removed by clamshell dredge and disposed of at the "Boston Foul Area."

I. EXISTING CONDITIONS IN THE STUDY AREA

The basic problem is one of extensive shoaling conditions on the river. Many of the boats that now use Weymouth Fore River are restricted to high tide conditions because the channel is not deep enough for all weather and tidal conditions. The depths within the channel are very shallow (2 feet at MLW), and in places the channel narrows to less than 13 feet. Some existing boats moor in or near the channel, thereby making it difficult and hazardous for other boats to make use of the channel. In order to avoid collisions with other craft, vessels traversing the channel run aground causing propeller and shaft damage or, by passing close to the channel edges, suck mud into their cooling systems causing fouling. The shoaling conditions have also reduced the environmental quality and nonboating recreational usage of the river.

Three drainage outfalls along both shorelines have been silted in by the shoaling. This has meant flooding of property within their particular watershed areas, causing damage and inconvenience. During the winter of 1978, this was particularly prevalent in the small residential area along the Weymouth shore, about 2000 feet downstream of the Quincy Avenue Bridge.

Other effects of the shoaling include the silting in of the Braintree Electric Light Department power plant's cooling water intakes and covering of the Mill Cove tidal flats thus damaging the clam beds.

The future stability of the Weymouth-Fore River as a viable recreation area is dependent on channel dredging. Present conditions have caused conflicts between nonboating recreational usages such as swimming and vessel usage. Providing an adequate channel to the river would increase the safety of navigating the river and increase the safety of recreational swimming. Furthermore, substantial reduction in vessel damages will occur.

II. ALTERNATIVES

1. PLANS OF IMPROVEMENT

To satisfy the need for improvements on the Weymouth Fore River, Weymouth-Braintree, Massachusetts, several alternative plans have been considered.

Plan A (the Selected Plan) - entails dredging a channel from the mainship channel to the Quincy Avenue Bridge. This plan provides an 8,000-foot long channel as follows:

A. Section 1 - a channel with a width of 100 feet and a depth of six feet at MLW beginning where the present 35-foot ship channel ends, and extending upstream 2,500 feet to the eastern end of Idlewell.

B. Section 2 - a channel with a width of 80 feet and a depth of six feet at MLW. This portion will begin where the 100 foot width ends and extend upstream for approximately 3,000 feet to the site of Watson Park.

C. Section 3 - a channel with a width of 60 feet and a depth of 6 feet at MLW. This portion begins where the 80-foot width ends and extends up to the Quincy Avenue Bridge (Plate 1). This would require dredging 31,000 cubic yards of material.

Plan B - entails dredging the same channel as Plan B except that dredging would continue 600 feet upstream of the Quincy Avenue Bridge. This would require dredging 39,000 c.y. of material.

Plan C - contains the same channel design elements in Plan B plus two anchorage areas with a combined total of 8 acres. The proposed location is shown on Plate 3. Anchorage area A, located on the south side of the channel, is approximately 4.6 acres and would accommodate approximately 33 vessels 25 feet in length. Anchorage area B is approximately 3.4 acres situated along the northern side of the river. This would require dredging 170,000 c.y. of material. This area would accommodate 24 vessels, 25 feet in length. The assumption of 57 vessels safely utilizing the anticipated anchorage area is based on the method of mooring commonly referred to as free swinging. The number of vessels moored in these two areas could be substantially increased should more efficient methods for anchoring be utilized.

2. DISPOSAL ALTERNATIVES

Several alternative disposal sites were considered; each method may have different environmental impacts. The major concerns for any disposal site are its potential impacts on water quality, wetland ecosystems and commercial marine resources. Four basic disposal options were considered: inland disposal, land disposal, marsh creation, and ocean disposal.

Inland disposal would entail the overland trucking of dredge material to a suitable landfill area. Utilization of this option would necessitate a large staging area, dewatering of sediment and a large amount of noise and dirt which accompanies the trucking away of sediment. The dewatering process can often take 2 to 3 years, rendering the site useless for the duration of this process. Once sufficiently dried, secondary handling is needed to move the material to a permanent location, usually a sanitary landfill. Based on local opposition to the noise and dirt problem and the unavailability of a staging area, this option is not considered feasible.

Land disposal near the channel area would have a severe environmental impact upon the wetland area adjacent to the shoreline. Diking these areas to retain the fill would be costly. Based on the two factors, this option was not considered feasible.

Studies contracted under the Army Corps of Engineers Dredged Material Research Program (DMRP) (2) have identified relevant criteria for selection of areas for artificial habitat creation using dredged materials. No sites in the Weymouth-Fore River area were identified using this criteria.

Ocean disposal is the only available alternative. The only active ocean disposal site located in the greater Boston area is the Boston "Foul Area." Ocean disposal dredged material must be evaluated under Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972. Evaluation procedures include bioassay testing of dredged material to determine potential toxicity and indicate adverse environmental effects at the disposal site resulting from the discharge. Bioassay test results indicate that ocean disposal of dredged material from Weymouth-Fore River is ecologically acceptable. Results of the bioassay tests are inclosed in Appendix 6. Bioaccumulation test (the process by which chemicals enter and build-up in the tissues of aquatic organisms) also show that the material is ecologically acceptable.

III. ENVIRONMENTAL CONSEQUENCES

1. BENEFICIAL IMPACTS

Implementation of the proposed plan would have several beneficial impacts. Dredging of the channel would provide for safe navigation in the area and add to a mixed usage of water recreation in the area. The quantifiable benefits attributable to the project are estimated at $362,100 annually.

2. PROBABLE ENVIRONMENTAL IMPACTS

DREDGING

The most direct biological impact of dredging is the physical removal of benthic organisms from the dredged area. While benthic organisms within the work area are expected to be destroyed by dredging, it is thought that removal of sediments may uncover "cleaner" material capable of supporting a healthier benthic community. Repopulation of the dredged area is expected to commence shortly after dredging is completed, with neighboring communities providing larva that will settle at the site.

Dredging is also expected to result in increased turbidity and suspended solids. While increased turbidity reduces the amount of sunlight available for phytoplankton photosynthesis, this effect is not considered significant because it is temporary. It does, however, lower aesthetics at the site. Again this would be temporary, lasting only as long as dredging continues.

As with turbidity, increased suspended solids are not expected to have any significant impacts on the biological community since tidal flushing will help remove fine grain suspended material that might impair respiratory processes of estuarine biota.

Initial sediment samples from Weymouth-Fore River were collected for analysis in February 1979. Several different tests were performed on the material to aid in assessing both the impacts associated with dredging and the probable impacts associated with ocean disposal. Table 1 show the results of the bulk sediment analysis while Plate 2 shows the location of sampling stations.

A comparison of bulk sediment analysis from the Fore River, the Boston Foul Area (3), and material from the Charles River Dam (4) is given in Table 2.

Sediments from the excavation of the Charles River Dam were disposed of at the Foul area in 1973 (3). Sediment testing of the Foul Area

TABLE 1
BULK SEDIMENT ANALYSIS
WEYMOUTH-FORE RIVER

Parameter Tested (% Dry Weight)	Lowest	Highest	Mean
Liquid Limit	80.0	87.0	83.75
Plastic Limit	34.0	39.0	36.02
Plastic Index	44.0	51.0	47.12
Grain Size - % Fine	88.2	96.7	92.7
% Solids	21.7	46.5	38.6
Sediment pH	7.0	7.4	7.2
Moisture content	-	-	-
Chemical Oxygen Demand COD (ppm)	106,000.0	146,000.0	131,000.0
Total Kjeldahl	2,290.0	4,110.0	3,138.0
Oil & grease (ppm)	598.0	5,750.0	3,603.0
Mercury (ppm)	.40	2.20	1.11
Lead (ppm)	51.0	230.0	148.8
Zinc (ppm)	246.0	546.0	352.4
Arsenic (ppm)	9.0	16.0	11.3
Cadmium (ppm)	3.7	9.8	6.1
Chromium (ppm)	41.0	123.0	91.8
Copper (ppm)	59.0	166.0	125.5
Nickel (ppm)	44.0	99.0	67.8
Vanadium (ppm)	80.0	560.0	269.1

TABLE 2
COMPARISION OF BULK SEDIMENT ANALYSIS
CHARLES RIVER DAM AND WEYMOUTH FORE RIVER

	Project Site	Charles River Dam
Oil & Grease (ppm)	3,603	45,182
% Vol/Sol	8.4	11.19
Mercury (ppm)	1.11	2.08
Lead (ppm)	148.8	659.9
Zinc (ppm)	352.4	829.4
Arsenic (ppm)	11.3	
Cadmium (ppm)	6.1	9.7
Chromium (ppm)	91.8	128.0
Copper (ppm)	125.5	341.7
Nickel (ppm)	67.8	

was performed in 1978 after the material from the dam had been deposited there. By comparing the data, there appears to be no accumulation of contaminants. Because the sediment that would be removed from the Fore River are considerably cleaner than those from the Charles River Dam, it could be assumed that there would be no accumulation of contaminants from this proposed project.

Elutriate tests on Weymouth-Fore River materials were performed by the Corps of Engineers in July 1979. Results are presented in Table 3. While these results indicate that low levels of phosphorus, zinc, vanadium, cadmium and oil and grease are likely to be released no clear cut impacts can be directly attributed to their presence. For example, while phosphorus has been known to stimulate algae blooms, the increased turbidity associated with both dredging and disposal results in decreasing the amount of sunlight available for photosynthesis and, consequently, may act to negate potential effects of high phosphorus concentrations.

The greatest concentrations of heavy metals and other contaminants are known to be associated with silt and clay sized sediments. The release of these contaminants into the water column is dependent upon the amount of water mixed into the sediments during dredging. However, since the material will be dredged with a clamshell dredge, the amount of water mix with the sediments will be sufficiently low so that little if any contaminants will be released at the dredge site. Overall, the release of heavy metals should not cause significant adverse impacts to the marine ecosystem since any increase would be quickly diluted to background levels. Those benthic organisms inhabiting the site have, by their very presence, demonstrated a tolerance to high concentrations of heavy metals. More mobile species such as fish are expected to avoid the area until dredging is completed at which time any constituents present would be diluted to background levels.

TABLE 3
ELUTRIATE TEST
NEW ENGLAND DIVISION LABORATORY, CORPS OF ENGINEERS
JULY 1979

Constituent	Dredge Site Water (Background Levels)	Standard Elutriate Replicate 1	Replicate 2	Replicate 3
Nitrate (N) mg/l	0.007	0.023	0.024	0.024
Nitrate (NO) mg/l	0.27	0.19	0.19	0.19
Sulfate (SO_4) mg/l	1,760	1,450	1,450	1,450
Oil & grease mg/l	<5	5	7	--
Phosphorus (P)				
Ortho mg/l	0.049	0.141	0.134	0.131
Total mg/l	0.058	0.153	0.158	0.163
Mercury (Hg) ug/l	<0.5	<0.5	<0.5	<0.5
Lead (Pb) mg/l	0.151	0.120	0.122	0.126
Zinc (Zn) mg/l	0.030	0.010	0.013	0.011
Arsenic (As) mg/l	<0.006	0.009	<0.006	0.006
Cadmium (Cd) mg/l	0.004	0.001	<0.001	0.001
Chromium (Cr) mg/l	0.011	0.038	0.033	0.034
Copper (Cu) mg/l	0.124	0.152	0.149	0.142
Nickel (Ni) mg/l	0.065	0.036	0.037	0.036
Vanadium (V) mg/l	0.052	0.136	0.128	0.123
Total PCB ug/l	.21	35	39	24
Total DDT ug/l	<0.1	<0.1	<0.1	<0.1

B. DISPOSAL

Disposal of dredged material will result in many of the same physical impacts associated with dredging. Dredge material will be point dumped at a designated location to insure dredge material is not released outside the disposal site. Some material will be suspended in the water column and dispersed by local currents. However, most of the dredge material is expected to descend quickly to the bottom, with little loss to the water column, and form a mound. Benthic organisms inhabiting the disposal site may be destroyed by burial, however, this is an active site, and therefore disruption of this site is common.

C. BIOASSAY

To determine possible adverse environmental impacts from disposing of dredged material in ocean water, EPA and the Corps of Engineers developed a manual for conducting bioassay tests. Bioassay tests subject sensitive marine organisms to dredged materials and any contaminants they may contain. There are three phases to the test - liquid, suspended particulate, and solid. Of these, the solid phase test is considered the most important.

Bioassay tests were conducted using Weymouth-Fore River sediment samples in February 1979. Based on criteria contained in the EPA/Corps manual, the proposed oceanic discharge of dredged material from Weymouth-Fore River was judged ecologically acceptable.

Results of the three phase bioassay tests show no statistically significant difference in survival of the test organisms when exposed to Weymouth-Fore River sediments. Complete results of the bioassay test can be found in Appendix 6.

D. THREATENED OR ENDANGERED SPECIES

There are no known threatened or endangered species inhabiting the project area nor would the proposed project modify critical habitat of any species in such a manner so as to jeopardize the continued existence of that species.

E. ARCHAEOLOGICAL AND HISTORICAL RESOURCES

Dredging is not expected to have any impact on known archaeological or historical resources.

F. OTHER IMPACTS

Another impact associated with the dredging is increased noise associated with operating the dredge, and its effect on nearby residents. In order to mitigate any possible excessive noise, dredging will only occur 16 hours a day for 5 days per week. This will allow the work to proceed expeditiously without any severe impacts on the local residents.

IV. AFFECTED ENVIRONMENT

HYDROLOGY

The Weymouth-Fore River is a mixed tidal estuary typical of the estuary systems found in the northeast. The tide at Weymouth is semidiurnal. The mean tide range is 9.5 feet above MLW and the spring range is approximately 11.5 feet above MLW.

There will be no changes in the tidal prism of the Weymouth-Fore River because no dredging will occur above MLW.

WATER QUALITY OF THE WEYMOUTH-FORE RIVER

The waters of the Weymouth-Fore River have been classified by the Commonwealth of Massachusetts as Class SB.

TIDAL MARSHES

The Weymouth-Fore River estuary has several marsh areas bordering the river.

The areas of fringing marsh along the river are dominated by saltmarsh cord grasses (S. alterniflora) and salt meadow cord grass (S. patens). Table 4 lists the common vegetation found along the river. Other plant species surrounding the river are indicative of upland vegetation.

The proposed project will not disturb any of these valuable marsh areas:

MAMMALS - The Weymouth-Fore River area is highly developed. However, habitat areas do exist for small mammals and birds. Those mammals commonly found in the area are listed in Table 5.

FINFISH - The Weymouth-Fore River and Smelt Brook, which enters the river at the Quincy Avenue Bridge, have been identified by the State as an anadromus fish run area.(1) Anadromous fish are those that live in salt water most of their life but spawn in fresh water. The primary fish in the run are Rainbow Smelt which spawn from March to May. Blue Back Herring which spawn from April to June have also been identified in the river. Table 6 shows the common finfish in the area.

TABLE 4

Common Vegetation Along the Fore River

Scientific Name	Common Name
TREES	
Acer rubrum	Red Maple
Pinus rigida	Pitch Pine
Prunus serotina	Black Cherry
Quercus alba	White Oak
Quercus rubra	Red Oak
Quercus velutina	Black Oak
Robinia pseudo-acacia	Black Locust
Salix babylonica	Weeping Willow
SHRUBS	
Clethra alnigolia	Sweet Pepperbrush
Iva frutescens	Marsh Elder
Myrica pennsylvanica	Bayberry
Rhus glabra	Smooth Sumac
Rosa rugosa	Beach Rose
Asparagus spp.	Wild Asparagus
Atiplex patula	Halbred-Leaved Orach
Convolvulus speium	Hedge Bindweed
Distichlis spicata*	Spike Grass

*Indicates Marsh Vegetation

TABLE 4 (Cont.)

Juncus geradi	Black Rush
Lathyrus japonicus	Beach Pea
Panicum longifolium	Panic Grass
Phragmites communis	Reed
Rhus radicans	Poison Ivy
Ruppia sp.	Widgeon Grass
Salicornia virginica*	Woody Glasswort
Smilax spp.	Green Briar
Solidago sempervirens	Seaside Golden Rod
Spartina alterniflora*	Salt-Meadow Grass
Spartina patens*	High Water Cord Grass
Suaeda martima	Sea Blite
Vitis spp.	Wild Grape

*Indicates Marsh Vegetation

TABLE 5

Common Birds and Mammals

Actitis macularia	Spotted Sandpiper
Agelaius phoeniceus	Red-Winged Blackbird
Columba livia	Pigeon
Corvus brachyrhynchos	Common Crow
Cyanocitte cristata	Blue Jay
Dendroica petechia	Yellow Warbler
Dumetella carolinensis	Catbird
Hylocichla guttata	Hermit Thrush
Ickerus galbula	Baltimore Oriole
Parus atricapillus	Black-Capped Chickadee
Parus bicolor	Tufted Titmouse
Passer domesticus	House Sparrow
Quiscalus giuscula	Common Grackle
Richmondena cardinalis	Cardinal
Sterna albifragus	Least Tern
Sterna hirundo	Common Tern
Sturuus vulgaris	Starling
Troglodytes aedon	House Wren
Turdus migratorius	Robin
Larus argentatus	Herring Gull
Larus attricille	Laughing Gull
Melospiza melodia	Song Sparrow

TABLE 6

Common Finfish in the Area

Alosa aestivalis	Blueback Herring
Osmerus mordax	American Smelt
Aquilla rostrata	American Eel
Fundulus heteroitus	Mamichog
Fundulus majalis	Striped Killfish
Merluccius bilinearis	Silver Hake
Microgadus tomcod	Atlantic Tomcod
Apeltas quadracus	Fourspine Stickleback
Pungitus pungitus	Ninespine Stickleback
Syngnathus fuscus	Northern Pipefish
Cyclopterus lumpus	Lumpfish
Ammodytes amdricanus	American Sand Lance
Menidia menidia	Atlantic Silverside
Pseudopleuronectes americanus	Winter Flounder

REFERENCES

(1) Coastal Zone Management Resource Atlas, 1976, Commonwealth of Massachusetts. p. 197.

(2) Coastal Zone Resources Corporation, 1976, Identification of Relevant Criteria and Survey of Potential Criteria and Survey of Potential Application Sites for Artificial Habitat Creation, Dredge Material Research Program, U.S. Army Corps of Engineers Report D-76-2.

(3) Disposal Area Monitoring Study, 1979, New England Division, Corps of Engineers, Waltham, Mass.

(4) Charles River Dam, Final EIS, 1971, New England Division, Corps of Engineers, Waltham, Mass.

V. PUBLIC AND AGENCY COORDINATION

The proposed project plan is being coordinated with the major Federal and State regulatory agencies represented by the U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, National Marine Fisheries Service and appropriate Massachusetts State environmental agencies.

These agencies as well as local officials from the town of Braintree were notified of the plan formulation and implementation schedule and plans. Local officials and residents had an opportunity to voice their concerns at a workshop held 12 March 1979. State and Federal environmental interests were consulted at an informal project workshop meeting on 6 April 1979. A formal public meeting was held 7 February 1980 at the Braintree High School, Braintree, Massachusetts.

Questions or comments relating to this report should be directed to the Acting Division Engineer, Colonel William E. Hodgson, New England Division, U.S. Army Corps of Engineers.

VII. FINDING OF NO SIGNIFICANT IMPACTS

The project as proposed calls for removing approximately 31,000 c.y. of silty-clay sediments by clamshell dredge and disposing of this material at the Boston "Foul Area." Dredging will provide a safe access channel, 6 feet deep (MLW).

The determination to prepare an Environmental Assessment, as opposed to an Environmental Impact Statement, was based on the following considerations:

a. No deleterious effects were noted when the Corps dredged portions of the Weymouth-Fore River during the period 1973 to 1975.

b. Successful bioassay test results indicated it is environmentally acceptable to dispose of Fore River sediments at an open water site such as the "Foul Area."

c. The recreational nature of the project will complement and enhance local land use.

d. There is presently available a suitable open water disposal site, i.e., the Boston "Foul Area," where fine grain sediments will match those from Weymouth-Fore River.

15 January 1981
DATE

William E. Hodgson
WILLIAM E. HODGSON
Colonel, Corps of Engineers
Acting Division Engineer

RECOMMENDATION

The Division Engineer recommends that a Federal navigation project at Weymouth-Fore River, Weymouth and Braintree, Massachusetts, be authorized by the Chief of Engineers under the provisions of Section 107 of the Rivers and Harbors Act of 1960, as amended.

The project would provide a channel 6 feet deep at MLW with a width from 60 to 100 feet. The channel would begin at the Federal ship channel in Quincy and extend 8,000 feet upstream to the Quincy Avenue bridge. The total project cost is estimated to be $400,000. Annual maintenance costs are estimated to be $16,000. The recommendation is made subject to the condition that local interests will:

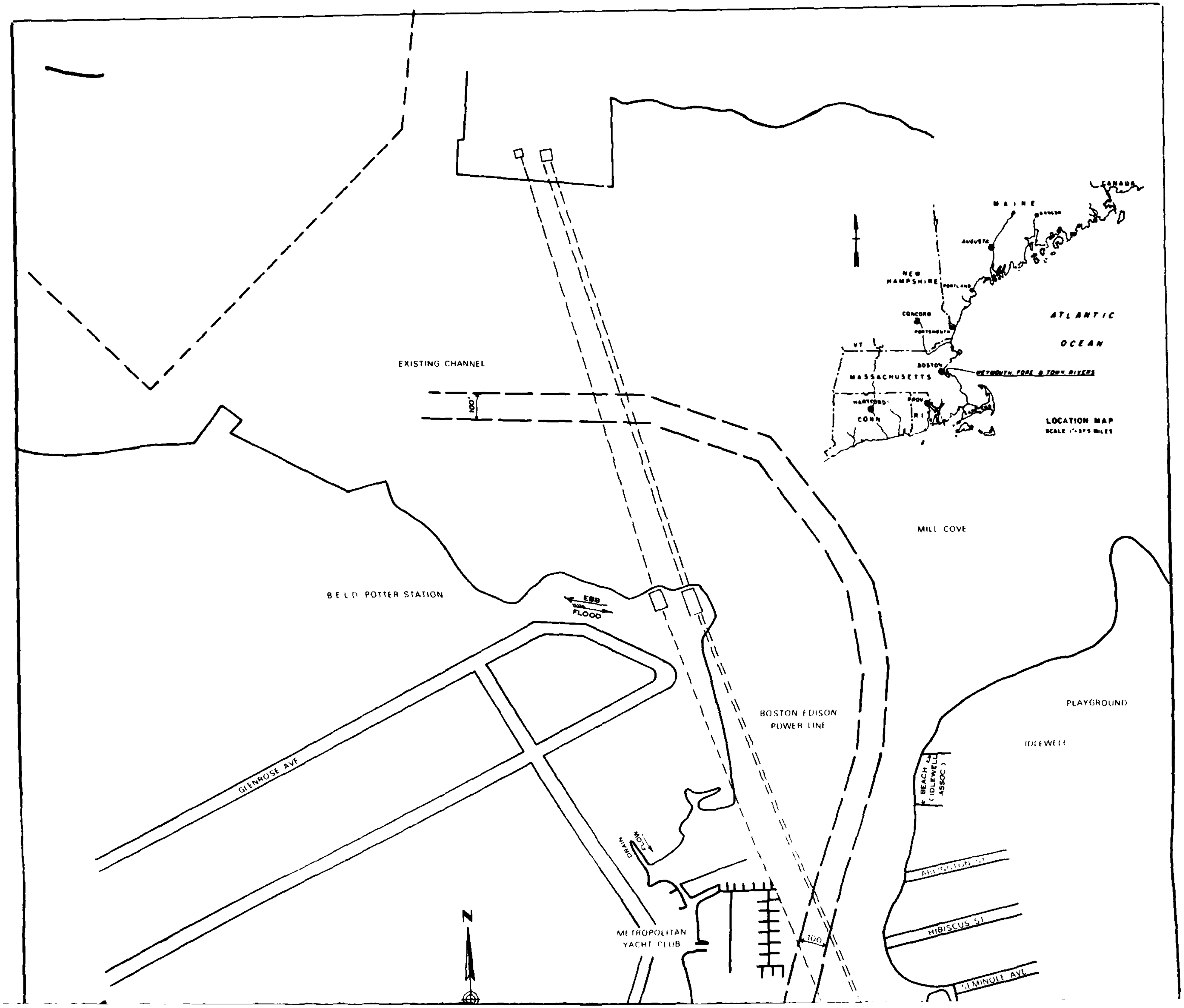
- Provide a cash contribution of 50 percent of the cost of construction, presently estimated to be $200,000.

- Provide without cost to the United States all necessary lands, easements, and rights-of-way required for construction and subsequent maintenance of the project including suitable dredged material disposal areas with necessary retaining dikes, bulkheads, and embankments therefor.

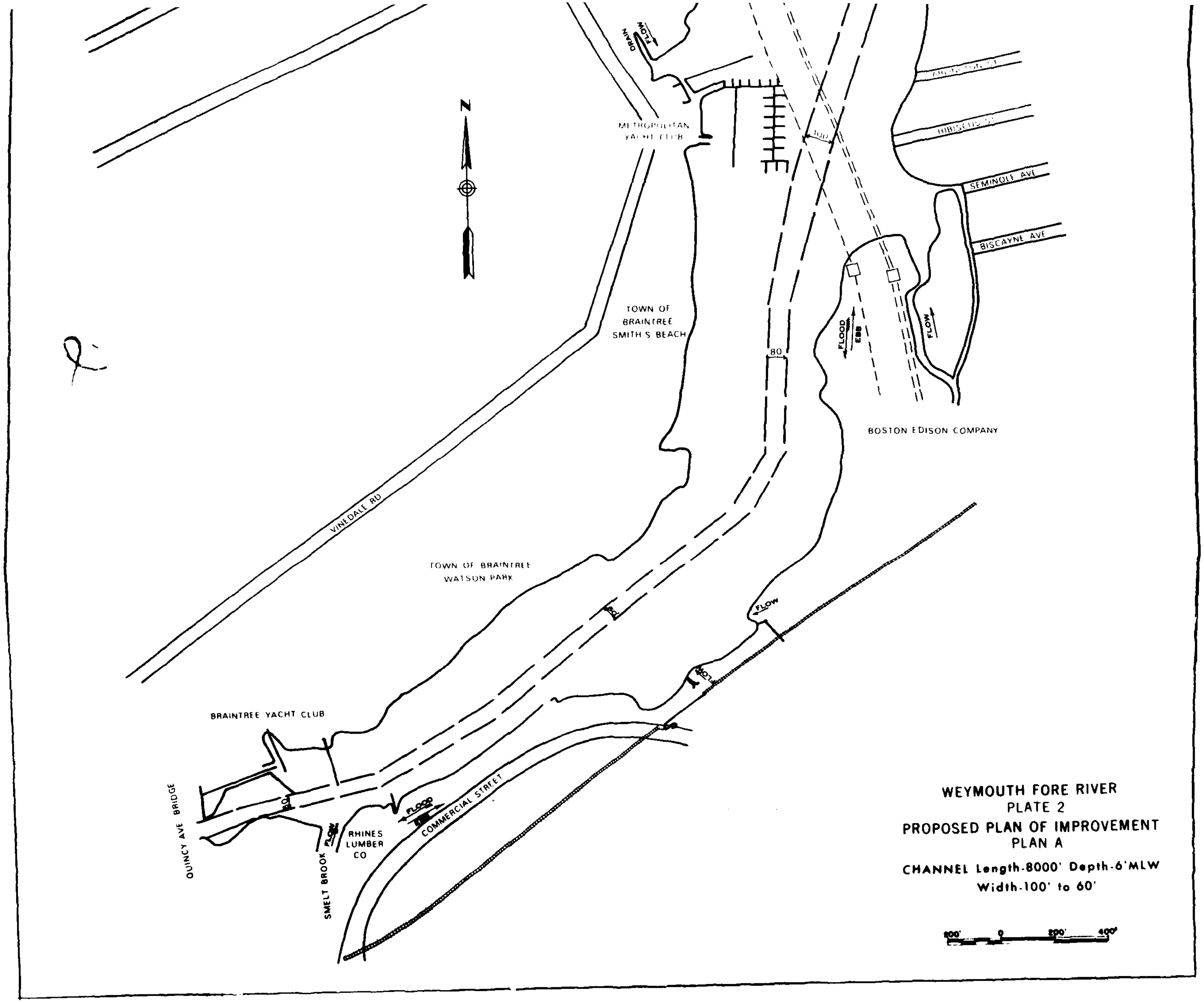
- Hold and save the United States free from damages that may result from construction and maintenance of the project.

- Provide and maintain berths, floats, piers, and similar marina and mooring facilities as needed for transient and local vessels as well as necessary access roads, parking areas, and other needed public use shore facilities open and available to all on equal terms.

- Establish regulations prohibiting the discharge of untreated sewage, garbage, and other pollutants in the waters of the harbor users thereof, which regulations shall be in accordance with applicable laws or regulations of Federal, state, and local authorities responsible for pollution prevention and control.

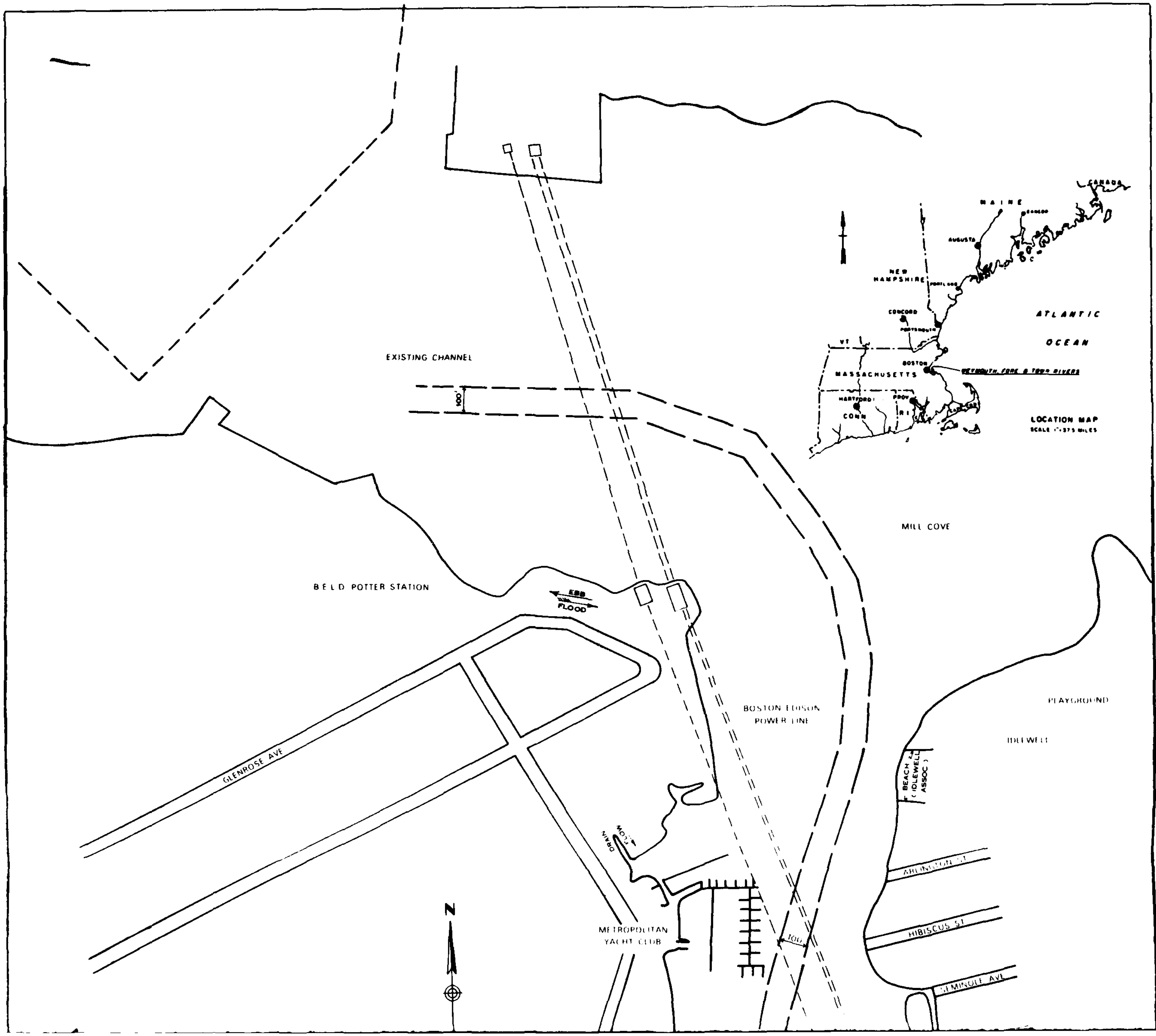


EXISTING CHANNEL
100'
BELD POTTER STATION
EBB
FLOOD
GLENROSE AVE
DRAIN
FLOW
METROPOLITAN
YACHT CLUB
N
BOSTON EDISON
POWER LINE
100'
MILL COVE
PLAYGROUND
IDLEWELL
BEACH (IDLEWELL ASSOC.)
HIBISCUS ST
SEMINOLE AVE
CANADA
MAINE
AUGUSTA
NEW HAMPSHIRE
PORTLAND
CONCORD
PORTSMOUTH
VT
BOSTON
MASSACHUSETTS
HARTFORD
PROV
CONN
R I
ATLANTIC
OCEAN
LOCATION MAP

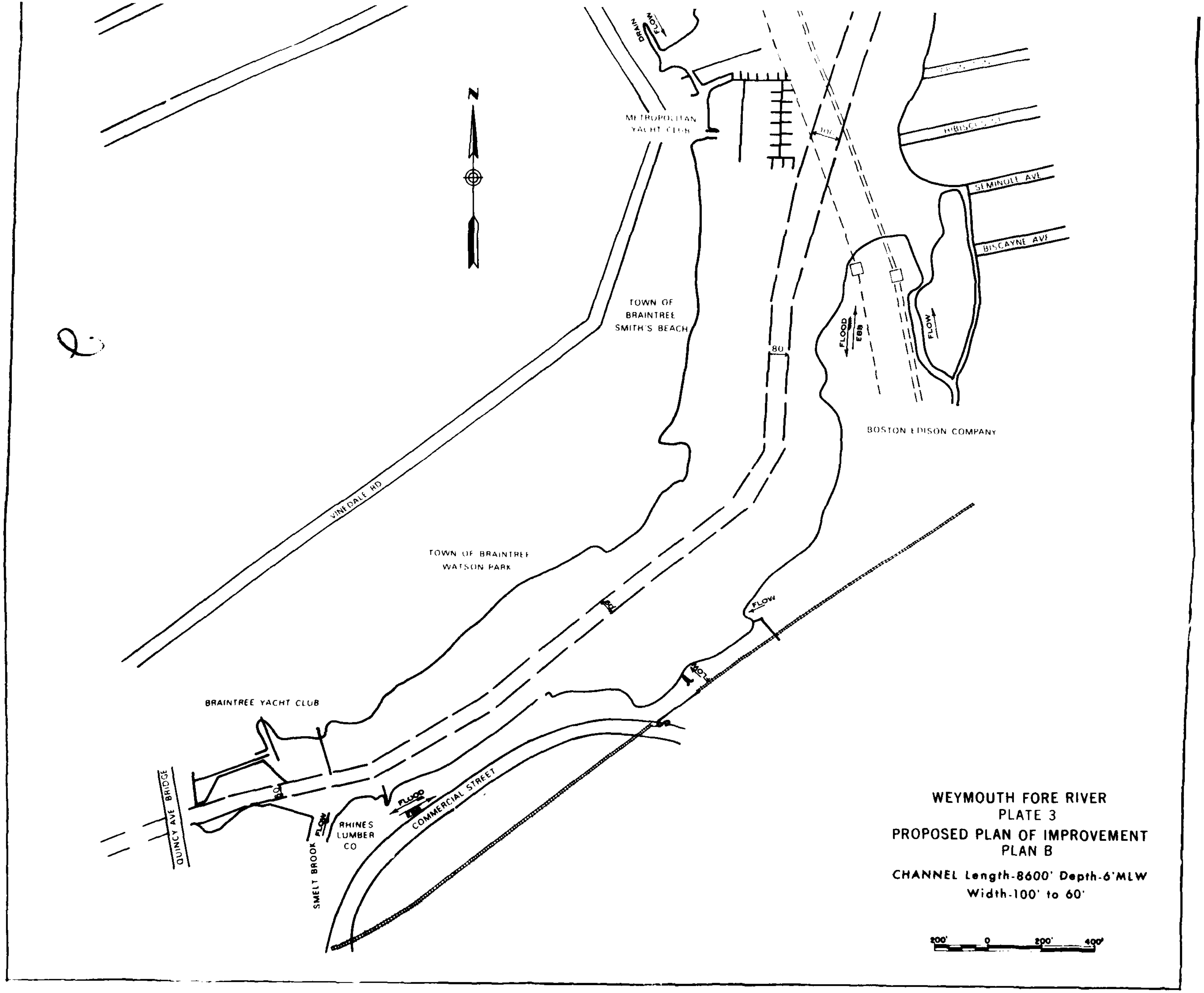


WEYMOUTH FORE RIVER
PLATE 2
PROPOSED PLAN OF IMPROVEMENT
PLAN A

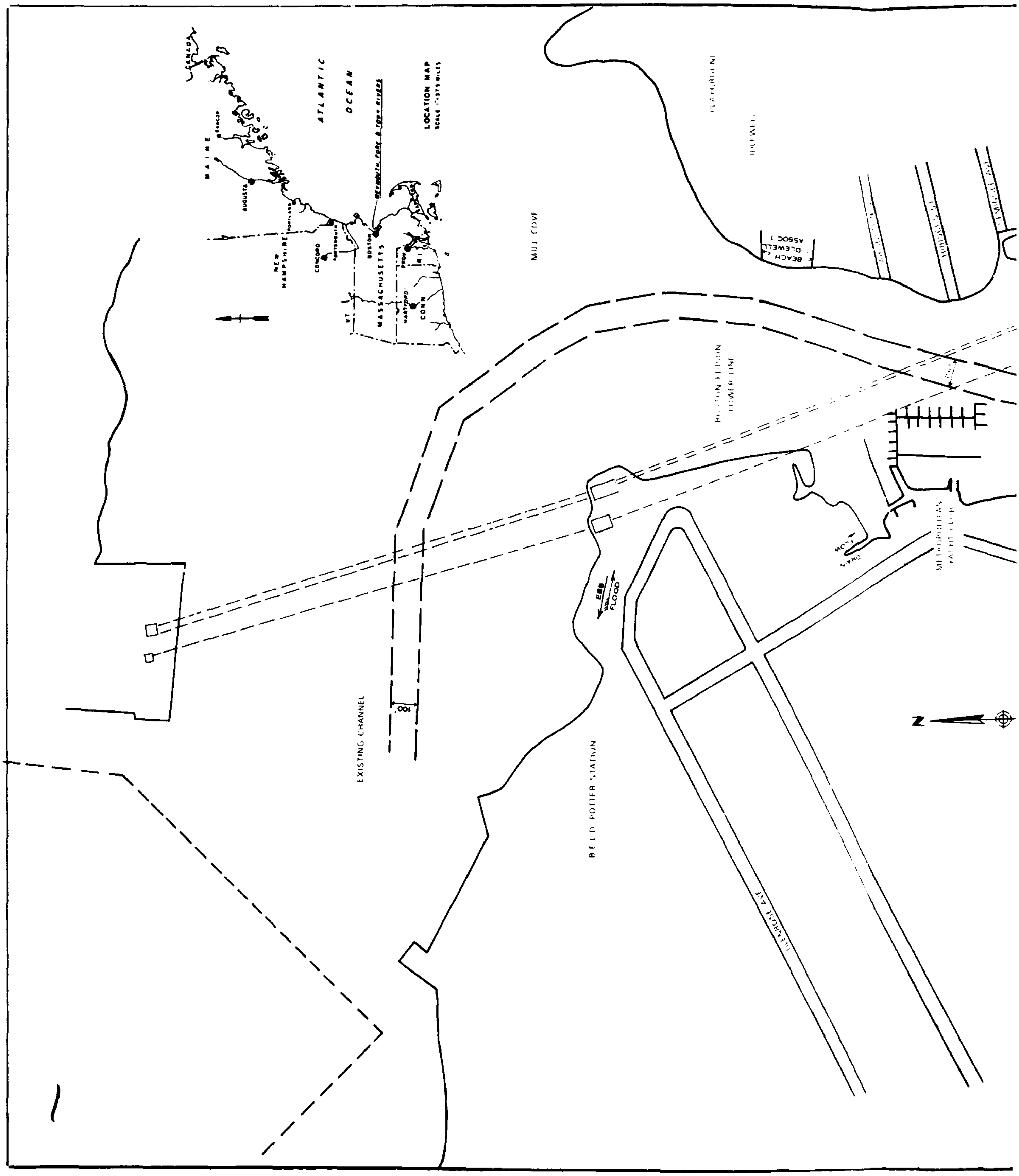
CHANNEL Length-8000' Depth-6'MLW
Width-100' to 60'



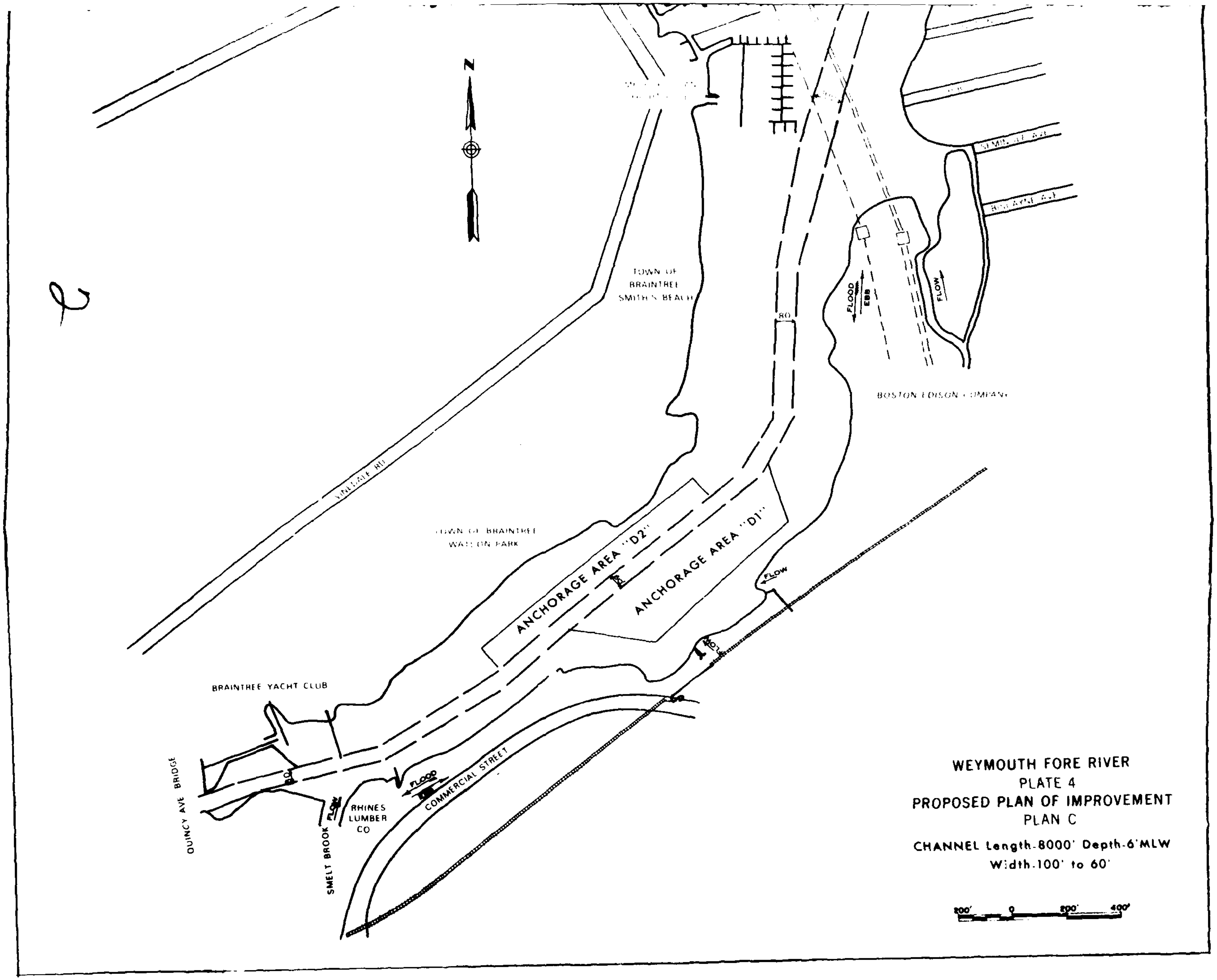
EXISTING CHANNEL
100'
BELD POTTER STATION
EBB
FLOOD
GLENROSE AVE
DRAIN
FLOW
METROPOLITAN
YACHT CLUB
N
BOSTON EDISON
POWER LINE
100'
MILL COVE
PLAYGROUND
IDLEWELL
BEACH
(IDLEWELL
ASSOC.)
ARLINGTON ST
HIBISCUS ST
SEMINOLE AVE
CANADA
MAINE
AUGUSTA
NEW
HAMPSHIRE
CONCORD
VT
BOSTON
MASSACHUSETTS
WEYMOUTH, FORE & TOWN RIVERS
HARTFORD
CONN
PROV
R I
ATLANTIC
OCEAN
LOCATION MAP



DRAIN
FLOW
METROPOLITAN YACHT CLUB
HIBISCUS ST
SEMINOLE AVE
BISCAYNE AVE
FLOOD
EBB
FLOW
80
TOWN OF BRAINTREE SMITH'S BEACH
BOSTON EDISON COMPANY
VINEDALE RD
TOWN OF BRAINTREE WATSON PARK
FLOW
BRAINTREE YACHT CLUB
QUINCY AVE BRIDGE
80
SMELT BROOK
RHINES LUMBER CO
FLOOD
COMMERCIAL STREET
WEYMOUTH FORE RIVER
PLATE 3
PROPOSED PLAN OF IMPROVEMENT
PLAN B
CHANNEL Length-8600' Depth-6'MLW
Width-100' to 60'
200' 0 200' 400'

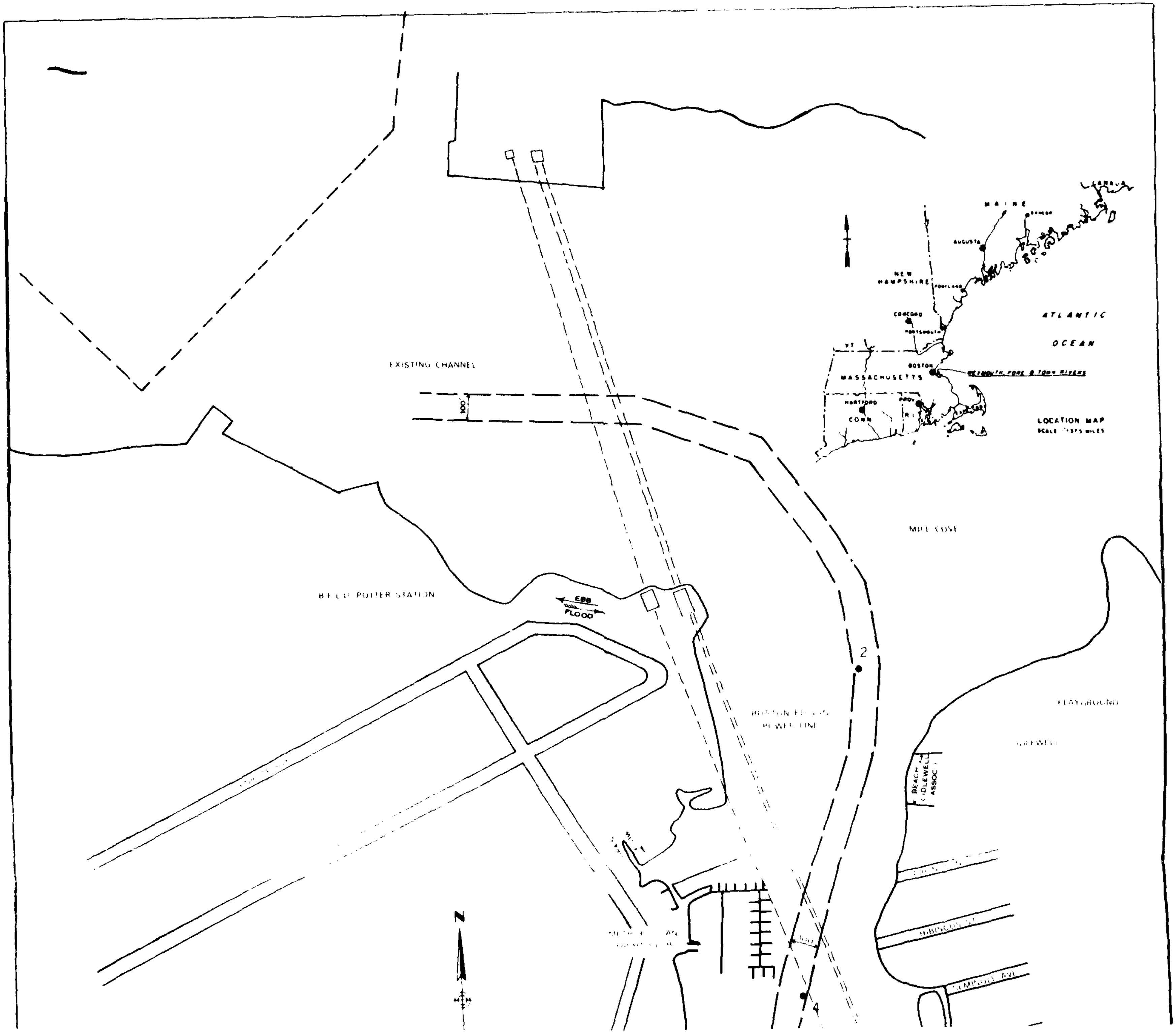


ATLANTIC
OCEAN
LOCATION MAP
WEYMOUTH FORE & TOWN RIVERS
MAINE
AUGUSTA
PORTLAND
NEW HAMPSHIRE
CONCORD
PORTSMOUTH
BOSTON
MASSACHUSETTS
PROV
R.I.
HARTFORD
CONN
VT.
CANADA
MILL COVE
EXISTING CHANNEL
100'
BOSTON EDISON POWER LINE
EBB
FLOOD
METROPOLITAN YACHT CLUB
BEACH & IDLEWELL ASSOC.
DRAIN
FLOW
N

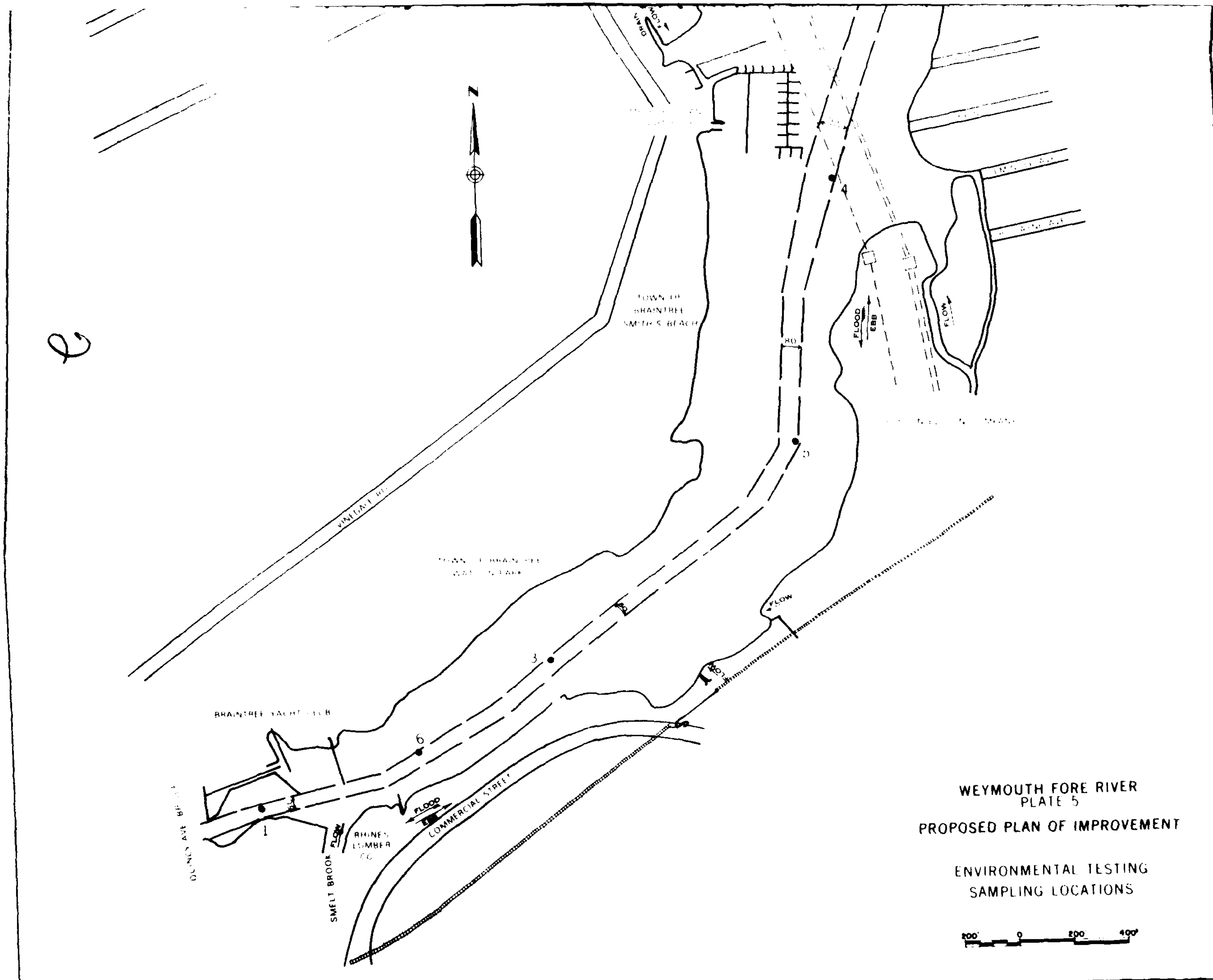


N
TOWN OF
BRAINTREE
SMITH'S BEACH
80
FLOOD
EBB
FLOW
BOSTON EDISON COMPANY
VINEYARD RD
TOWN OF BRAINTREE
WATSON PARK
ANCHORAGE AREA "D2"
ANCHORAGE AREA "D1"
FLOW
FLOW
BRAINTREE YACHT CLUB
QUINCY AVE BRIDGE
80
FLOOD
COMMERCIAL STREET
RHINES
LUMBER
CO
FLOW
SMELT BROOK
WEYMOUTH FORE RIVER
PLATE 4
PROPOSED PLAN OF IMPROVEMENT
PLAN C
CHANNEL Length-8000' Depth-6'MLW
Width-100' to 60'
200' 0 200' 400'

2



EXISTING CHANNEL
100'
B E L D POTTER STATION
EBB
FLOOD
MILL COVE
2
4
PLAYGROUND
BEACH
(IDLEWELL ASSOC.)
HIBISCUS ST
SEMINOLE AVE
N
MAINE
BANGOR
AUGUSTA
NEW HAMPSHIRE
PORTLAND
CONCORD
PORTSMOUTH
VT
MASSACHUSETTS
BOSTON
WEYMOUTH, FORE & TOWN RIVERS
HARTFORD
CONN
PROV
R I
ATLANTIC
OCEAN
LOCATION MAP

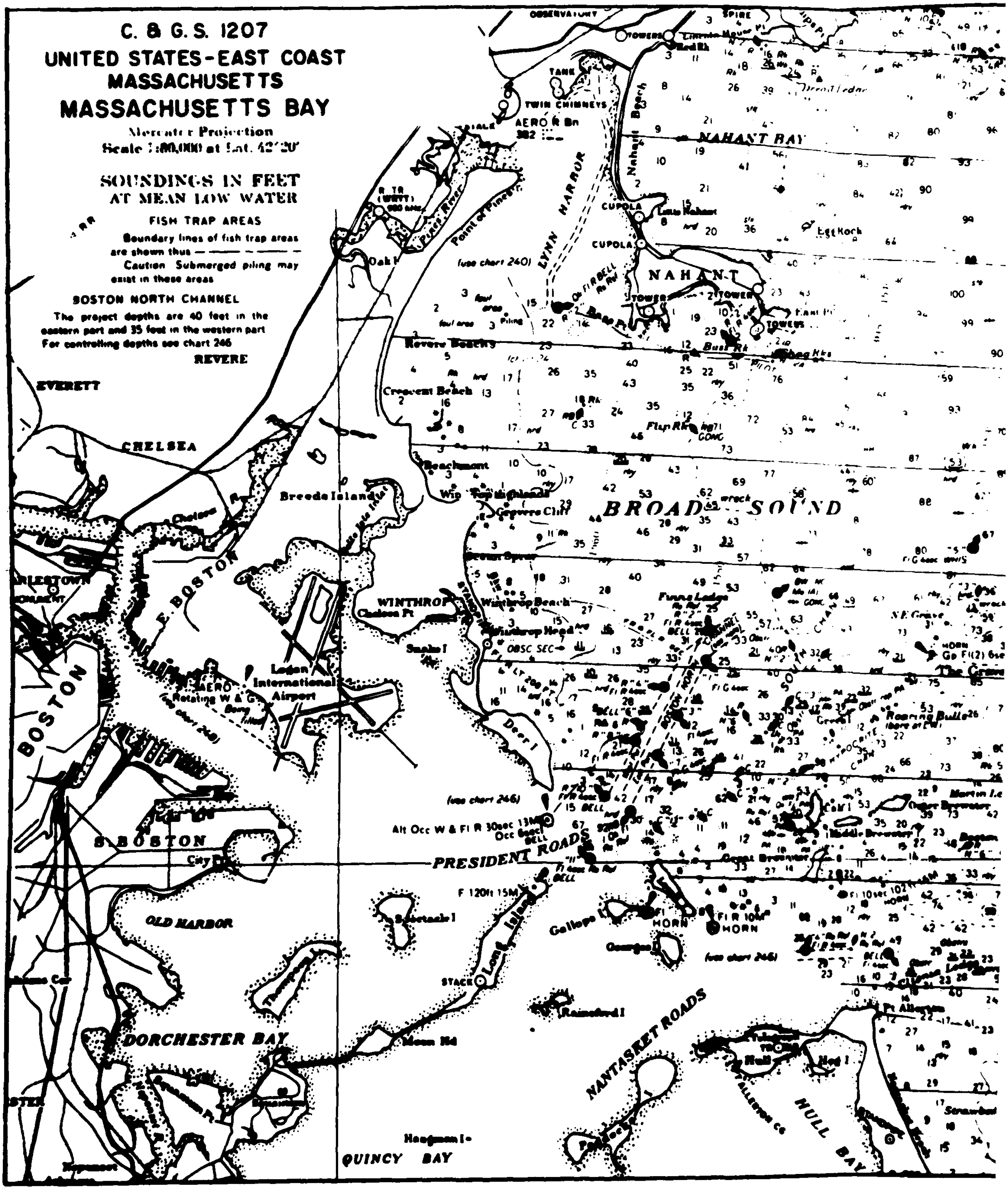


WEYMOUTH FORE RIVER
PLATE 5

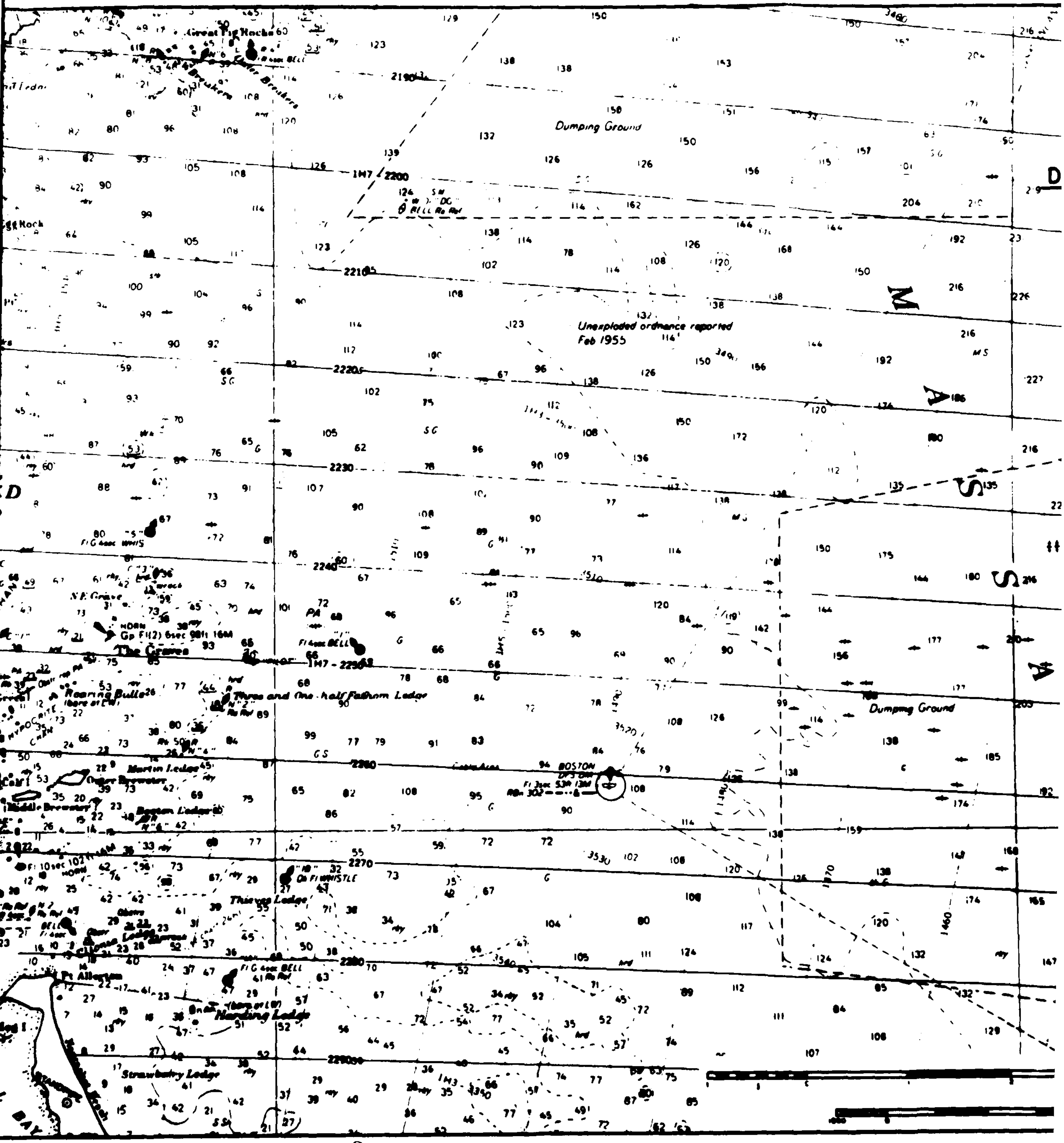
PROPOSED PLAN OF IMPROVEMENT

ENVIRONMENTAL TESTING
SAMPLING LOCATIONS

200' 0 200 400'



C. & G. S. 1207
UNITED STATES-EAST COAST
MASSACHUSETTS
MASSACHUSETTS BAY
Mercator Projection
SOUNDINGS IN FEET
AT MEAN LOW WATER
FISH TRAP AREAS
Boundary lines of fish trap areas are shown thus
Caution Submerged piling may exist in these areas
BOSTON NORTH CHANNEL
The project depths are 40 feet in the eastern part and 35 feet in the western part
For controlling depths see chart 246
REVERE
EVERETT
CHELSEA
NAHANT BAY
LYNN HARBOR
NAHANT
Revere Beach
Crescent Beach
Breeds Island
BROAD SOUND
E. BOSTON
WINTHROP
Winthrop Beach
Winthrop Head
Logan International Airport
BOSTON
Deer I
PRESIDENT ROADS
S BOSTON
OLD HARBOR
Long Island
NANTASKET ROADS
DORCHESTER BAY
Moon Hd
Rainsford I
HULL BAY
QUINCY BAY
Roaring Bulls
Outer Brewster
Middle Brewster
Great Brewster
Gallops I
Georges I
Spectacle I
Thompson I
Hull
Pt Allerton
TWIN CHIMNEYS
CUPOLA
TOWER
HORN
BELL
GONG
(use chart 246)
(use chart 2401)


Great Pig Rocks
Dumping Ground
Unexploded ordnance reported
Feb 1955
Egg Rock
N.E. Grave
The Graves
Roaring Bulls
Three and One-half Fathom Ledge
Martin Ledge
Outer Brewster
Middle Brewster
Boston Ledge
Thieves Ledge
Pt Allerton
Harding Ledge
Strawberry Ledge
BOSTON
Dumping Ground

2

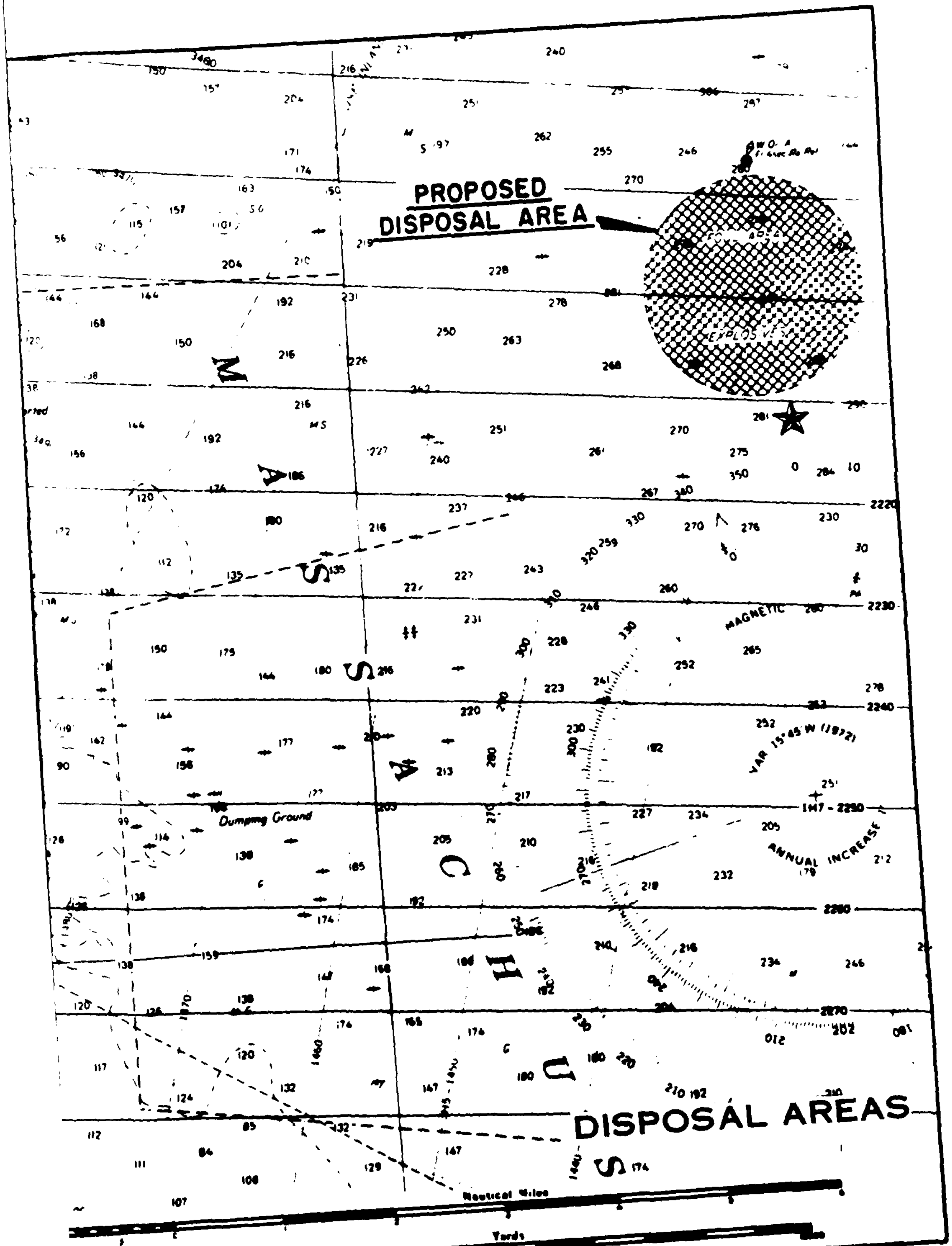
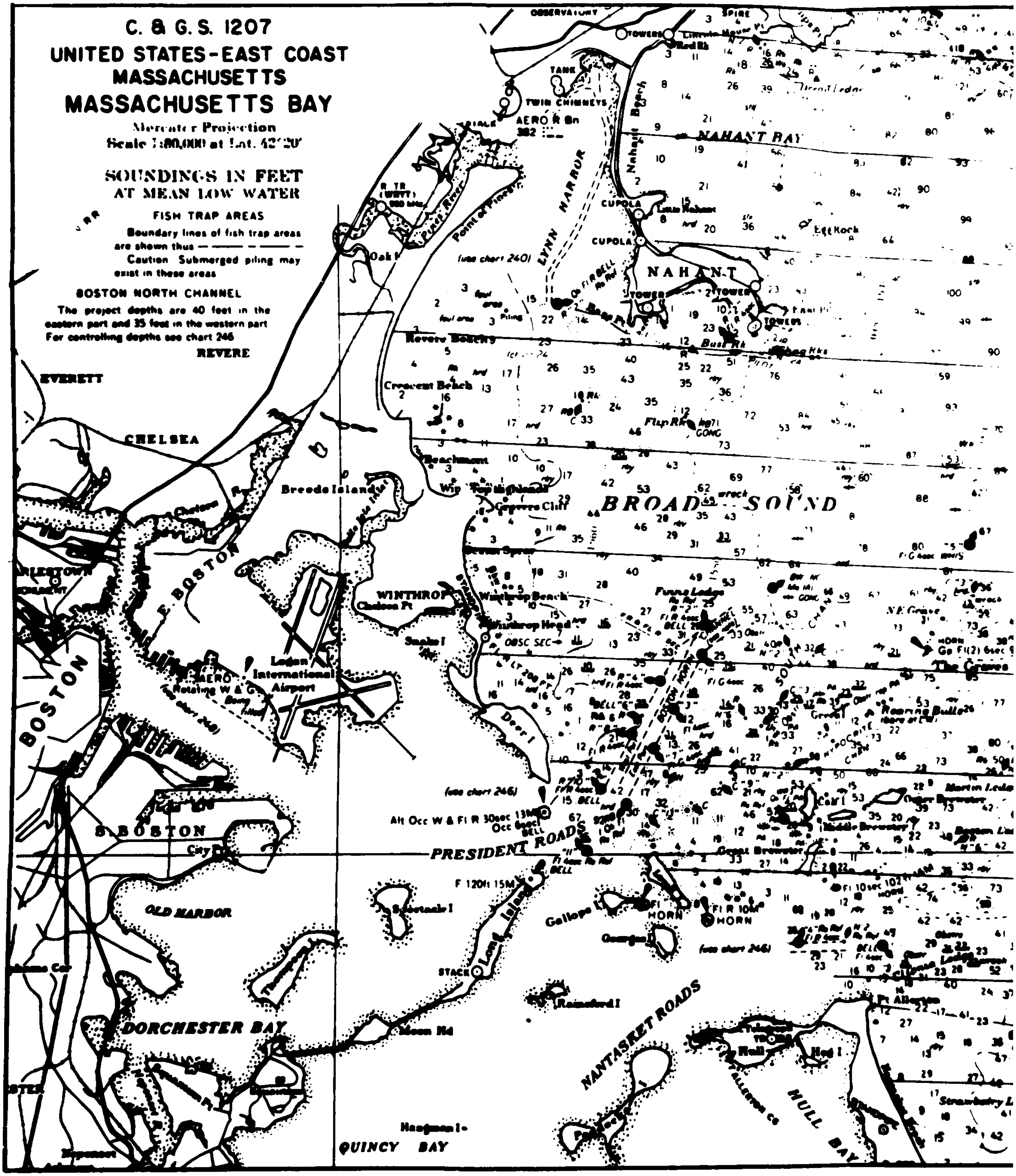

PROPOSED DISPOSAL AREA
FOUL AREA
EXPLOSIVES
MASSACHUSETTS
Dumping Ground
MAGNETIC
VAR 15°45'W (1972)
ANNUAL INCREASE
DISPOSAL AREAS
Nautical Miles
Yards

PLATE NO. 6


C. & G. S. 1207
UNITED STATES-EAST COAST
MASSACHUSETTS
MASSACHUSETTS BAY
Mercator Projection
SOUNDINGS IN FEET
AT MEAN LOW WATER
FISH TRAP AREAS
Boundary lines of fish trap areas are shown thus
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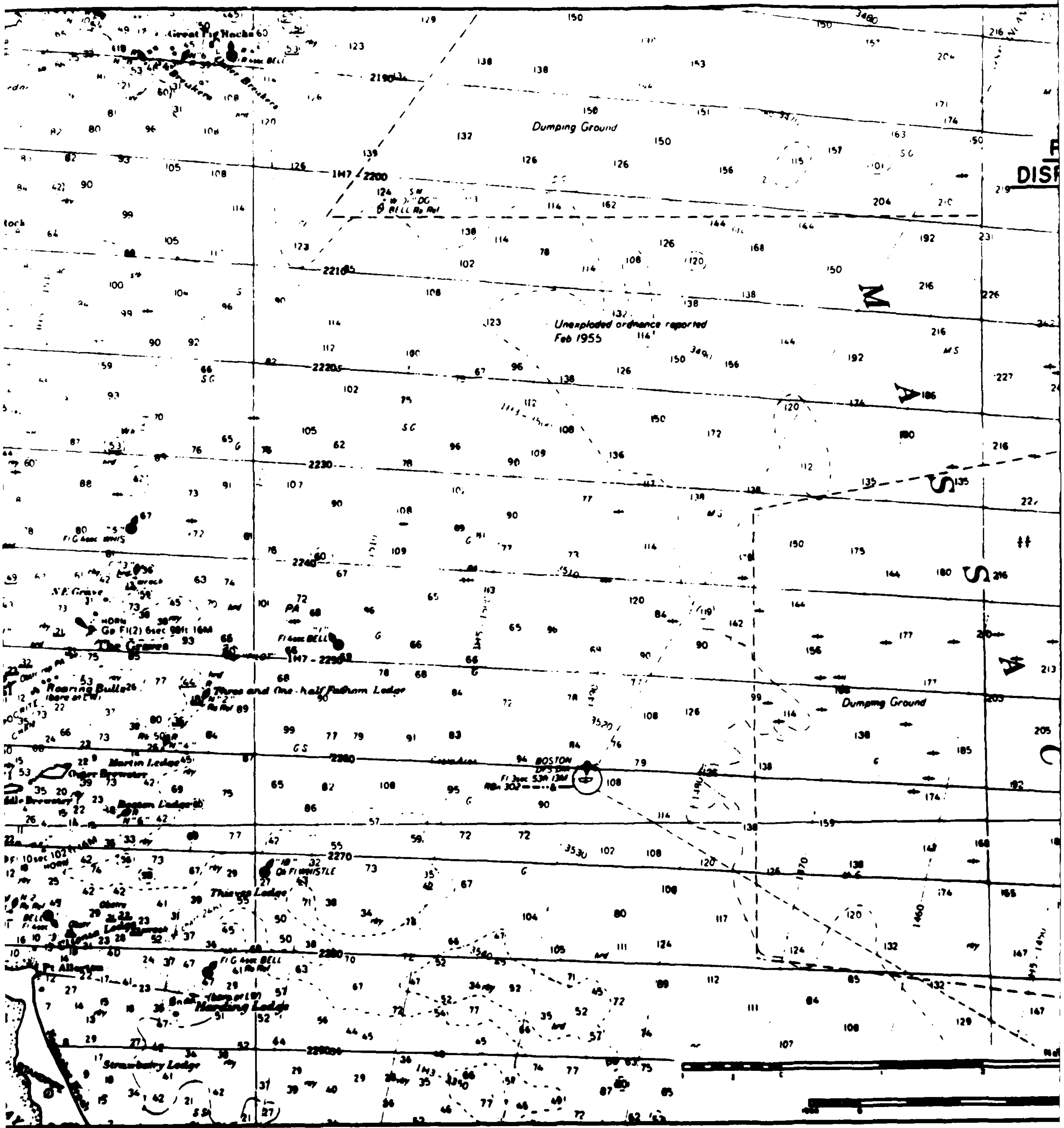
REVERE
EVERETT
CHELSEA
E. BOSTON
BOSTON
S. BOSTON
WINTHROP
NAHANT
NAHANT BAY
LYNN HARBOR
BROAD SOUND
PRESIDENT ROADS
NANTASKET ROADS
OLD HARBOR
DORCHESTER BAY
QUINCY BAY
HULL BAY
Logan International Airport
Revere Beach
Crescent Beach
Breeds Island
Winthrop Beach
Winthrop Head
Deer I
Long Island
Moon Hd
Gallops I
Georges I
Rainsford I
Thompson I
Spectacle I
Hull
Pt Allerton
Middle Brewster
Great Brewster
The Graves
Roaring Bulls
Point of Pines
Nahant Beach
Egg Rock
Bass Pt
(use chart 240)
(use chart 246)
Alt Occ W & Fl R 30sec 13M
F 120ft 15M
CUPOLA
TOWER
TANK
TWIN CHIMNEYS
OBSERVATORY
SPIRE
STACK
HORN
BELL
GONG


Great Pig Rocks
Dumping Ground
Unexploded ordnance reported Feb 1955
The Graves
Roaring Bulls
Three and One-half Fathom Ledge
Martin Ledge
Outer Brewster
Boston Ledge
BOSTON
Thieves Ledge
Pt Allerton
Harding Ledge
Strawberry Ledge
Dumping Ground

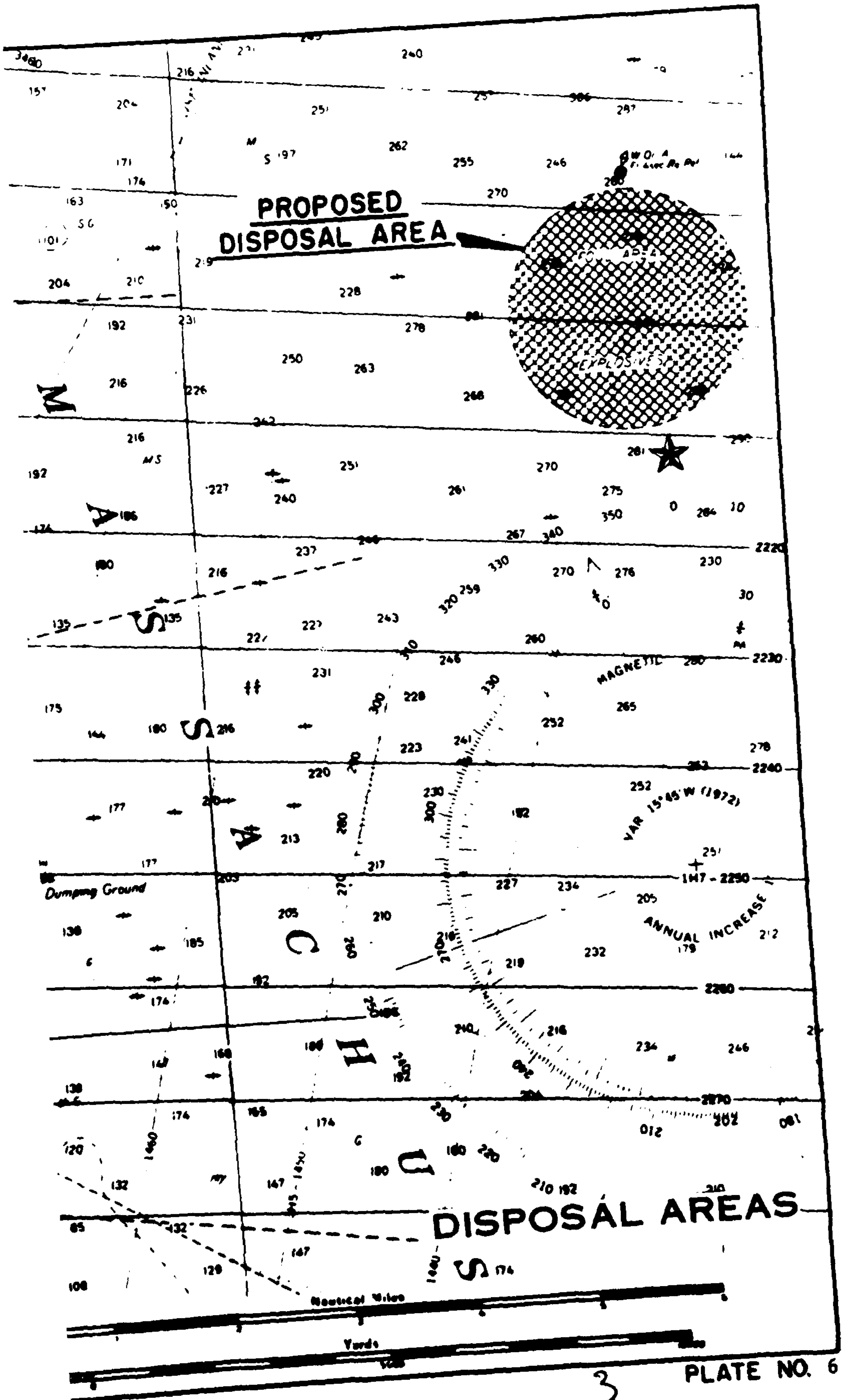

PROPOSED DISPOSAL AREA
EXPLOSIVES
M
A
S
S
A
C
H
U
S
Dumping Ground
MAGNETIC
VAR 15°45'W (1972)
ANNUAL INCREASE
DISPOSAL AREAS
Nautical Miles
Yards

PLATE NO. 6

3

Acknowledgement and Identification of Personnel

The preparation of this report was administered by:

Colonel William E. Hodgson, Jr., Acting Division Engineer
Joseph L. Ignazio, Chief, Planning Division
Donald W. Martin, Chief, Coastal Development Branch
Robert C. MacDonald, Chief, Small Navigation Projects Section

Study management and plan formulation was directed by Project Manager, Lydia J. Wood. The Environmental Assessment was prepared by Del Kidd. The Economic Analysis was prepared by Warren E. Weiner.

The New England Division is appreciative of the cooperation and assistance rendered in connection with this study by personnel of other Federal offices and agencies; by State and municipal authorities; and particularly by the following:

Gale Engineering Inc., Consulting Engineers, Braintree, Massachusetts

Raytheon Environmental Oceanographic Services, Consulting Engineers, Portsmouth, Rhode Island

The Metropolitan Yacht Club, Braintree, Massachusetts

The Massachusetts Boat Owners Association, Braintree, Massachusetts

The Joint Dredging Committee, Weymouth-Braintree, Massachusetts

WEYMOUTH FORE RIVER
WEYMOUTH AND BRAINTREE, MASSACHUSETTS

DETAILED PROJECT REPORT

PROBLEM IDENTIFICATION
APPENDIX 1

Prepared By:

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

PROBLEM IDENTIFICATION

Table of Contents

List of Plates

PROBLEM IDENTIFICATION

SECTION A

ANALYSIS OF EXISTING CONDITIONS AND TRENDS

This appendix containing information supplementing the first two sections of the Main Report, Introduction and Problem Identification, describes previous studies and reports, describes the existing and projected future (without project) conditions, identifies problems and needs of the study area, describes the national objectives, and sets forth the planning objectives and constraints developed for this project.

PRIOR STUDIES AND REPORTS

There have been no previous studies of the proposed area of improvement on the Weymouth Fore River. The study area, however, is bordered by two existing Federal projects. These are: The Weymouth Fore and Town Rivers, Boston, Massachusetts. Deep Draft Navigation Project (H. D., 247, 88th Congress, 2nd Session), and the Smelt Brook Flood Control Project.

A channel 8,000 feet long, 60 feet wide, and 5 feet deep at MLW was dredged in 1956 by the Commonwealth of Massachusetts.

In January 1977, the New England Division of the U.S. Army Corps of Engineers prepared a Small Boat Navigation Project Reconnaissance Report to determine the need for further detail study of navigation improvements in the Weymouth Fore River. The Reconnaissance Report indicated that a project would have an acceptable benefit/cost ratio and recommended that a detailed study be undertaken. This report summarizes the study process used in and the results of that detailed study.

SCOPE OF THE STUDY

The scope of this study is limited to navigation improvements. Several problems within the study area that were not directly related to navigation were identified during the study process and are explained in the Main Report and this appendix. However, due to the limited scope of the study, solutions were not expanded upon for these non-navigational problems. The geographic scope was limited to that area within the physical limits of the Weymouth Fore River, upstream of the existing federal project as described in the following sections.

LOCATION

The Weymouth-Fore River is located approximately nine miles from downtown Boston. It flows into Hingham Bay which forms the southern portion of Boston Harbor. The river forms a portion of the boundry between the cities of Weymouth and Braintree.

DESCRIPTION OF THE STUDY AREA

The Weymouth Fore River is a twisting tidal estuary fed by two major streams, Monatiquot River which enters upstream of the Quincy Avenue Bridge and Smelt Brook which enters downstream from this location. It is located in the southerly region of Boston Harbor. Reference to Plate 7, a land use map of the study area, will make the following discussion of land use more meaningful.

The project area includes only that portion of the river channel from a point just upstream of the State Route 53 Quincy Avenue Bridge downstream to the main ship channel (35´ MLW) opposite General Dynamics Shipyard. It is an L-shaped body with the long stem running in a southwest to northeast direction and the short stem in a southwest to northwest direction. The total length of the project area is approximately 9,000 feet.

The northerly shoreline is almost entirely owned by the town of Braintree. The upstream half is under Park Commission control (Braintree Yacht Club, Watson Park, Smith´s Beach), the downstream section under the Braintree Electric Light Department (Potter plants). Parcels are also owned by the Metropolitan Yacht Club, Boston Edison and Cities Service. The land inshore is single-family residential exclusively. The shoreline consists almost entirely of filled land, with a small salt marsh between Watson Park and Smith´s Beach being the only exception.

The southerly shoreline consists of four portions. The upstream end (1,500´) is occupied by various commerical uses (Boston Gas - Braintree, Rhine´s Lumber - Weymouth) which have bulkheaded the shoreline to prevent erosion and increase available land. Smelt Brook flows into the channel approximately 500´ seaward of Quincy Avenue on this shore. The central portion consist of salt marsh and filled land owned by Boston Edison and extends seaward to Idlewell. Various transmission towers have been constructed in this area. Idlewell, a single-family residential neighborhood with a small beach, is the next portion. The last portion is the Mill Cove tidal flat and the Boston Edison generating plant.

Depths range from two (2) feet at MLW to eleven (11) feet at MLW in the meandering channel, and the width varies from thirteen (13) feet to 10 feet. The average depth is less than five (5) feet at MLW. The mean tidal range is 9.5 feet and the spring range is approximately 11.5 feet.

The northerly shoreline is, for the most part, filled land. The Braintree Yacht Club land, next to the Quincy Avenue Bridge, is gravel fill with some deciduous trees (maple and oak) and grasses growing on the unpaved area. Watson Park is bordered by a retaining wall along the river. Shoreward are vaious playing fields planted with grass and several trees located between the various fields. On the river side of the wall is a strip of marsh area about five (5) yards wide dominated by salt marsh grasses. This marsh area widens beyond the seaward end of the wall to a maximum of 50 yards with similar vegetation predominating. This marsh area gradually reduces to only a gravel beach about 100 years from Smith´s

Beach. In this area, the deciduous tree growth in the rear of the residences extends to within five (5) yards of high water. The beach, located between two stone jetties, is clean sand from low water back about 60 yards to the roadway. Several small maple trees are planted near the roadway. The Metropolitan Yacht Club has a parking lot, club building and various piers and launching facilities located on the abutting land. A filled marsh, roughly 60 yards square, is adjacent to a small (10 yards wide) inlet of the estuary adjoining the seaward side of the Yacht Club mooring area. This area was filled with material from the channel dredging in 1956 and is now above mean high water to a great extent; however, it is still characterized by salt marsh vegetation. The next 100 yards of the shoreline is a gravel beach about 20 yards wide which ends in deciduous tree growth, similar to the area on the westerly side of Smith's Beach. A small peninsula of filled land on which is located two (2) large transmission towers separates this portion from another section of gravel beach and deciduous growth which extends to the B.E.L.D. Potter Plant site. The Potter Plant site itself is characterized by grass species and a short (5 yard) gravel beach at the base of a steep bank.

The southerly shoreline consists of four (4) distinct sections. The upstream end is, for the most part, bulkheaded with a variety of materials (timber, concrete, granite). The remaining area is a steep gravel bank to the water. This is little vegetation in the tidal zone, although some marine creatures (barnacles, crabs, snails) do live in the spaces within the bulkheads and rock ripraps. Smelt Brook enters the river within this section and, because of the poor mixing of trees and salt water, the marine life has been reduced. The next area is a combination of salt marsh and filled "marsh" on which power transmission towers have been erected. The fill consists of water from the coal-burning Edison plant downstream which has been covered with peat. A dense growth of grasses and shrubs (goldenrod, blueberry, staghorn sumac) covers much of this area. A five-yard width strip of marsh separates this are from the river on one side and a small stream on the other side (outfall from Cranberry Pond). The remainder of this area, from the stream to Idlewell, is a natural salt water marsh dominated by marsh grasses and disturbed only by a series of manholes for the sewer line buried at its periphery.

Next is Idlewell, a single-faily residential community built on the shoreline. A gravel beach extends from about ten (10) yards above high water to the mud, which is located at about the lower water mark. A small, sandy beach is located across from the Metropolitan Yacht Club for use of the neighborhood residents. Some clam diggers have been observed in this area although their success is limited. There are several small clumps of marsh grass along the shore and typical marine life (crabs, mussels, snails) living within the beach area. A playground is located on filled land protected by rock riprap at the end of Idlewell. A 10-yard wide marsh has developed at the base of the banks with the attendant aquatic life. A large tidal flat, Mill Cove, occupies the majority of the remaining area. This is considered to be a valuable habitat for many forms of marine life and, therefore, any detrimental environmental impacts on it should be minimized. At the downstream end of the channel is the Boston Edison power

plant. This complex is located behind a bulkhead which extends well above the high water mark. The plant has been shut down with no plan to reopen in the future. Thus, it has little, if any, effect on the environment of the study area.

PRESENT NAVIGATION

Presently navigation within the study area is restricted to periods of high tide. Even boats of shallower draft, which can utilize the area during low tide are restricted to a narrow passage, as shown in Plate 8.

PROBLEMS WITHIN THE STUDY AREA

The controlling depths within the existing channel are very shallow (2 feet MLW) and in places the channel narrows to less than 13 feet. Some existing boats moor in or near the channel thereby making it difficult and hazardous for other boats to make use of the channel. In order to avoid collision with other craft, vessels traversing the channel run aground causing propeller and shaft damage or, by passing close to the channel edges, suck mud into their cooling systems causing fouling.

The extensive shoaling has caused a reduction of the natural tidal flushing action in the river. This has caused a decrease in the water quality due to stagnation and inadequate dilution of freshwater; thus damaging the marine organisms present in the estuary.

The shoaling has also affected the bathing beaches located on the river's shoreline. The deposits of silt have drastically reduced the depth of water at low tide, causing swimmers to venture farther from shore and into the existing channel in search of water with sufficient depth. This has caused problems both to the personal safety of the swimmers and the increased possibility of boat damage due to collision or grounding.

Various drainage outfalls along both shorelines have been silted in by the shoaling. This has meant flooding of property within their particular watershed areas, causing damage and inconvenience. During the winter of 1978, this was particularly prevalent in the small residential area along the Weymouth shore, about 2000 feet downstream of the Quincy Avenue Bridge.

Other effects of this shoaling include the silting in of the Braintree Electric Light Department power plant's cooling water intakes and the covering of the Mill Cove tidal flat; thus damaging the clam beds. Another effect is the occurrence of extensive mud flats along both shorelines with the attendant environmental impacts on aesthetics and air quality.

REGIONAL BOATING PROBLEMS IN THE BOSTON HARBOR AREA

This section gives an analysis of the recreational boating demands in the greater Boston area and some trends for the future.

The greater Boston area suffers from a shortage of recreational ships due to the great demand for recreational boating and a limited supply of suitable marina facilities. Development of marinas is limited by a lack of available undeveloped shoreline areas next to sheltered waters and by environmental factors. Discussions with the marine operators indicated that some have waiting lists of up to five years for space and have stopped taking applications. In the Braintree-Weymouth area alone there are six yacht clubs and marinas all presently filled to capacity. There are several factors which have indicated this shortage. Even though from 1977 to 1980 there was a 50% increase in facilities in the Greater Boston area, vessel ownership increased 6.5% per year during this same time frame. Within this 20% increase in fleet size the demand is presently running 62% above supply. Increases in the fleet size are expected to continue at 6.5% per year or approximately 30% through 1985. Based on projects both Federal and non-Federal currently being planned, potential facilities may increase by 21% through 1985. These projections for increased ownership have been made assuming a recessionary economic picture. This projection could increase if recessionary trends do not continue.

The National Marine Fisheries Service and the Massachusetts Division of Marine Fisheries expressed concern over preservation of the intertidal zone. Because the extent of the intertidal zone habitat is limited, efforts should be expended to preserve remaining areas. Marine life in this zone serves as a food source for finfish. The agencies felt that it may become a more important resource in the long term as water pollution is abated. Soft-shell clams were found in the intertidal zone near the mouth of the river. Altough the river is closed to shellfishing because of pollution, the existing shellfish population can be held to repopulate other shellfish beds in the area.

Due to these concerns, development, not only in the Fore River, but all of Massachusetts Bay will be limited in the future.

FUTURE CONDITIONS WITHOUT A FEDERAL PROJECT

Several scenarios based on the Federal Government not participating in the project were developed. These were then comparatively evaluated and the most likely scenario designated the most probable future.

ALTERNATIVE FUTURES

Scenario 1. Private developers, State and local governments would undertake the dredging of the river.

Scenario 2. No dredging by any group or person would occur.

EVALUATION

Several factors occuring recently make Scenario 1 unlikely. First, even though the non-Federal interest have costs sharing monies in hand they

do not have sufficient funds to construct the full channel. Furthermore, if these cost sharing monies are not obligated soon they will be lost to the communities by the summer of 1981. It would also not be in the public interest to force locals to dredge the channel themselves since all studies have indicated the overwhelming benefit to be realized by the general public if the Federal Government particiated in improvements.

Scenario 2 would cause a decrease in utilization of the area, accompanied by economic, social, aesthetic and environmental loss. Without any project in the area the river will continue to silt in at its present rate. This would in the long run force the fleet to relocate. Continued siltation without dredging would futher exacerbate the other problems in the river, i.e., pollution, disruption of clam flats, power plant intake clogging, etc. The yacht clubs and boat yards would be ruined, and most likely not recover from this economic distruction. Also in the long term this could degrade the residential areas along the river. A decrease in usage of this area would put even more pressure on recreational facilities in the region.

MOST PROBABLE FUTURE

Based on the above facts scenario 2 is the most probable future.

NEEDS

Based on the problems in the study area, the needs of the recreational fleet in the Boston area and the most probable future of the area. Two distinct navigational needs can be identified.

- The area needs a safe navigable channel.
- The demand for boating facilities throughout the region is so extensive and new development areas are so limited that maximum utilization of existing facilities is needed.

OPPORTUNITIES

Based on the problems and needs outline, there are three unique opportunities available. They are:

- help the communities to continue utilizing an important local recreational resource and economic base;
- help prevent an increase in the already large regional need for recreational boating facilities; and,
- help support local and State interest in their attempt to address area problems and needs.

SECTION B

PLANNING OBJECTIVES AND CONSTRAINTS

PLANNING CONSTRAINTS

Planning constraints are those parameters which can place limitations on any proposed plan of improvements. As limitations, they are used to direct plan formulation and restrict impacts, cutting across a broad spectrum of concerns. These concerns may include natural conditions within the project site, technological states of the art, economic limits, and legal restrictions.

In conjunction with dredging of the lower reach of the Weymouth Fore River for a deep draft ship channel, many of the residents are familiar with dredging operations. Their past experience has been noisey and continuous, and included blasting of bed rock material. Even though the proposed plan will not include and rock removal, the residences are concerned about noise control. At a meeting these concerns were expressed and a 16 hour day was agreed upon.

At this same meeting and those subsequent during the study process, non-Federal interest indicated that their maximum cost sharing limit is $320,000. This is documented in letters inclosed in Appendix 3.

Other concerns identified during the planning process included protection of intertidal areas and the river anadromous fish run.

In light of expressed concerns and physical characteristics of the study area, this study has identified 4 site specific constraints that impact on the selection of a plan of improvement for the Weymouth Fore River. They are:

a. Due to the recreational nature of this project, non-Federal costs must be kept within the communities' ability to pay.

b. Because the river is an anadromous fish run, construction must occur only during the fall months.

c. Construction should occur on a 16-hour day, 5 day week, to minimize any adverse noise effects on the residents living near the river.

d. Salt marsh and tidal flats in the study area should be preserved.

e. The Quincy Street Bridgei s a fixed span structure with a height of 21.4 ft. of MLW. Boat traffic upstream of this point would therefore be constricted to vessels above to navigate beneath this height.

PLANNING OBJECTIVES

Planning objectives for this study were established after carefully analyzing the identified concerns regarding the use of water and related land resources in this study area. The purpose of these planning objectives is to translate identified needs, opportunities and problems into specific objectives for this study.

Based on the problems, needs, and opportunities found in the study area, the following objectives have been identified:

a. Contribute to navigation safety for recreational purposes in the Weymouth Fore River during the 1980-2030 period of analysis.

b. Contribute to the full utilization of existing recreational boating facilities in the Weymouth-Fore River during the 1980-2030 period of analysis.

OPEN SPACE/NATURAL RESOURCES

INDUSTRIAL

RESIDENTIAL

WATER

GENERALIZED LAND USE MAP

PLATE 7

SHOALING CONDITIONS ON THE FORE RIVER

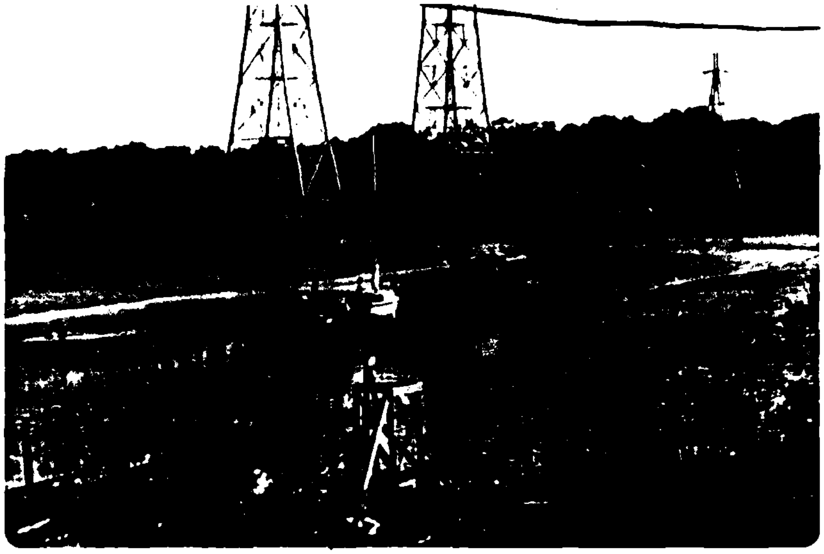


PLATE 8

WEYMOUTH FORE RIVER
WEYMOUTH-BRAINTREE, MASSACHUSETTS

DETAILED PROJECT REPORT

FORMULATION AND EVALUATION OF DETAILED PLANS
APPENDIX 2

Prepared By:

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NEW ENGLAND DIVISION

FORMULATION AND EVALUATION OF DETAILED PLANS

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FORMULATION AND EVALUATION OF DETAILED PLANS

In order to formulate a plan of improvement for the Weymouth Fore River that is responsive to area needs and consistent with National and local objectives, criteria presented in Appendix 1 must be utilized to guide both the formulation of alternative plan and eventually, their evaluation. These criteria are used as a guide to develop reasonable and responsive management measures to deal with identified resource problems and needs. These management measures can then be developed into alternative plans of improvement which can be evaluated against identified criteria and relative attainment of objectives and opportunities to identify the optimum plan of improvement for the Weymouth Fore River.

SECTION A

FORMULATION AND EVALUATION CRITERIA

In order to logically develop and assess plans, criteria have been generated from previously identified problem and needs; recognized local and national objectives; sound engineering principles; and complete consideration of environmental resources, social values, and potential cultural resources. These criteria reflect identifiable measures of plan performance that can be utilized in the System of Accounts to evaluate detailed plans. These criteria were kept in mind in formulating alternative plans of improvement but the problems and needs of the study area were paramount in this formulation. These criteria are of most use in the eventual evaluation of alternative plans.

Criteria to be used in planning of navigation improvements for the Weymouth Fore River were divided into four basic categories and are identified below.

TECHNICAL CRITERIA

- The selected plan should allow for maximum use of existing facilities by the recreational fleet now utilizing the Weymouth Fore River.

- Channel dimensions should allow for safe unimpeded passage of vessels now using or expected to use the river throughout the project life.

- The selected plan should minimize improvement dredging and future maintenance dredging by selecting optimum channel locations.

ECONOMIC CRITERIA

- The selected plan should maximize net benefits (project benefits minus project costs).

- The selected plan should minimize local costs.

- The selected plan should maximize the net return that boat owners in the Fore River realize on their investment.

- The selected plan should help existing marina facilities realize optimum operational efficiency.

- The selected plan should encourage regional economic growth through the stimulation of navigation-related businesses.

ENVIRONMENTAL CRITERIA

- The use of natural resources to affect plan implementation should be minimized.

- The selected plan should minimize the volume of dredging to reduce disposal impacts. Impacts on water quality, noise impacts, and all other impacts related to dredging.

- The selected plan should not disrupt anadromous fish runs.

- The selected plan should minimize impacts on environmental resources such as tidal wetlands and salt marshes.

- The selected plan should call for scheduling of construction activities that minimize disruption to normal activities in the study area.

SOCIAL AND CULTURAL CRITERIA

- The selected plan should encourage activities compatible with community and State development goals.

- The selected plan should maximize the safety of persons utilizing navigational and other resources related activities in the Fore River.

- The selected plan should not damage or destroy any potentially valuable cultural resources.

- The selected plan should maximize cultural and aesthetic contributions to the Fore River area.

- The selected plan should be in conformance with local desires as much as possible.

SECTION B

FORMULATION OF DETAILED PLANS

The many criteria developed above were first utilized in developing management measures that would be responsive to area needs. Management measures were then screened to identify those which were practically applicable to the existing situation in the Weymouth Fore River and those management measures carried forward were used to guide the formulation of meaningful plans of improvement.

DEVELOPMENT OF MANAGEMENT MEASURES

The paramount need in the study area is the need for improved navigation conditions for the existing recreational fleet. Basically, four managmeent measures can be identified that would generally address this type of problem:

(1) Improvement dredging
(2) Move facilities downstream to areas of naturally deeper water
(3) Relocate the fleet to other existing facilities in the region
(4) Navigation aids and tidal controls under existing conditions

It will be noted that of the four measures only the first involves a structural type solution. The other three are basically non-structural type solutions.

In screening these management measures, consideration cannot only be given to economic expense to the Federal Government, but economic and social impacts on local resources.

The idea of moving activities downstream to areas of naturally deep water was eliminated from further consideration for several reasons. First, the movement of facilities is financially impractical. The cost of acquiring new lands (if they are available), constructing new facilities, disposing of the old facilities, etc., far exceeeds the cost of providing adequate access to existing facilities. Secondly, the environmental impacts of developing new land sites and new marine facilities would far exceed the improvement of an existing navigation channel. Thirdly, the strain on the existing infrastrucutre would be needlessly great. It is simply not practical to expend the costs required for relocation in light of the many adverse impacts and the lack of any favorable impacts.

Relocation of the fleet to other existing facilities in the region is not only impractical for reasons sited in the discussion of relocating facilities above, but is impossible due to a documented lack of available facilities in nearby regional ports.

The idea of placing navigation aids in the channel and practicing tidal navigation is not a viable measure. Channel dimensions are, in any

locations so narrow that no navigation aid would assist navigation. Tidal navigation of the channel is already standard practice and is currently one of the greatest navigation problems identified. Therefore, tidal navigation is not considered further since it is not responsible to identified problems and needs. Navigation aids will be part of any final navigation system in the Fore River but are not considered further as a solution in themselves.

In light of the above discussion, it is concluded that improvements to navigation to optimize the use of existing facilities is the most desirable management measure since it is most responsible to local needs and desires, most economically efficient, and least taxing on the existing social structure.

The idea of dredging will be carried forward for consideration in formulating alternative plans. This management measure is most in accordance with local desires for improvement. It fully utilizes the existing facilities and infrastructure that represents a considerable financial investment and a part of the local social structure.

NO IMPROVEMENT OPTION

The "No Improvement Option" simply involves the continuation of existing conditions. It is identified and evaluated mainly to be used as a baseline condition for evaluation and relative comparison of detailed plans of improvement.

DESCRIPTION OF DETAILED PLANS OF IMPROVEMENT

In order to formulate reasonable improvement plans, each plan must at least provide what is considered to be minimum conditions for safe and efficient navigation in the Weymouth Fore River. Based on identified characteristics of the existing fleet, and projected dimensions of vessels in the anticipated future fleet, a minimum depth of 6 feet MLW and a minimum width of 60 feet would be required to provide safe navigation conditions in the channel. Therefore, all plans provide for a channel of at least these dimensions. A detailed discussion of channel dimensions is included in Appendix 4.

Through discussions with local interests and detailed examination of the study, the following three plans were identified as those which should be examined in detail.

Plan A. Plan A, which is shown on Plate 2, involves dredging of a channel as follows:

- Section 1 with a width of 100 feet and a depth of six feet at MLW beginning where the present 35-foot channel ends, and extending upstream, 2,500 feet to the eastern end of Idlewell.

- Section 2 with a width of 75 at a depth of six feet MLW. This portion will begin where the 100-foot width ends and extend upstream for approximately 3,000 feet to the site of Watson Park.

- Section 3 with a width of 60 feet and a depth of six feet at MLW. This portion begins where the 75-foot width ends and extends upstream for approximately 2,500 feet to the Quincy Avenue Bridge.

This entails dredging approximately 31,00 cubic yards of material. The dredged disposal would be at the Boston "Foul Area" 29 N miles from the river. This site is shown on Plate 5.

Plan B. Plan B, which is shown on Plate 3, involves the same channel dimensions as Plan A but also includes extending the 60 foot width channel approximately 600 feet upstream past the Quincy Avenue Bridge at depth of six feet MLW. This would involve dredging a total of 39,000 cubic yards of material.

Plan C. Plan C contains the channel design elements in Plan A plus two anchorage areas for a combined total of eight acres. The proposed location is shown on Plate 4. Anchorage area 1 located on the south side of the channel, is approximately 4.6 acres and would acommodate approximately 33 vessels, 25 feet in length. Anchorage area 2 is approximately 3.4 acres in size situated along the northern side of the river. This area would accommodate approximately 24 vessels, 25 feet in length. The assumption of 57 vessels safely utilizing the anticipated anchorage area is based on the method of mooring commonly referred to as free swinging. It is conceivable that the number of vessels mooring in these two areas could be subtantially increased should more efficient methods be used.

Plan C would reuqire the dredging of 170,000 cubic yards of material, of this 6.5 acres would be from intertidal areas.

SECTION C

EVALUATION AND COMPARISON OF DETAILED PLANS

The evaluation of detailed plans of improvement for Weymouth Fore River was predicated on the relative attainment of various evaluation criteria outlined above designed to assure that a plan of improvement be identified that responds to local problems and needs and fulfills national and planning objectives.

All State and local objectives were also considered in developing the selected plan of improvement for Fore River. These objectives were based on State and local needs for improvement, including disposal of dredged material.

By evaluating each alternative plan against a complete and standard set of criteria, a comparative trade-off analysis can be performed which should lead to a definite conclusion of which plan of improvement is the optimum plan of improvement for the Weymouth Fore River.

EVALUATION

Below, each plan is evaluated separately by measuring its relative fulfillment of all the identified criteria.

Plan A. Plan A provides for full utilization of the project by the existing fleet. All vessels now using or expected to use the project during the project life would be proivded safe, unrestricted use of the channel. The plan would require that 31,000 cubic yards be dredged. As described in Appendix 5, this plan would have a total cost of $400,000, while providing the opportunity to attain $362,100 in annual benefits yielding a benefit/cost ratio of 7.8 to 1. By providing navigation channels that are sufficient for all vessel traffic, each boat owner will realize maximum return on his vessel investment, existing marina facilities will be able to maximize their operational efficiency, and regional navigation operations will be optimized.

The plan will minimize any impacts on intertidal zones by limiting dredging to areas of current navigational subtidal areas, impacts on anadromous fish runs. This plan is fully compatible with local development plans and actually is that plan requested by local interests.

Plan B. Plan B provides for full utilization of existing marina facilities and also provides a short channel extension that will service a few of the local users upstream of the Quincy Avenue bridge. The plan would require the dredging of 39,000 cubic yards of material. The plan would have a total cost of $534,000 while providing benefits of $362,100. Therefore, yielding a benefit/cost ratio of 5.8 to 1. Boat owners at facilities downstream of the Quincy Avenue bridge still realize maximum return on their vessel investments and existing marina facilities would be able to maximize the efficiency of their operations.

Because of the fixed height of the Quincy Avenue bridge, traffic is kept to small vessels mostly outboards and smaller inboards. Furthermore, there are several engineering complications which make dredging upstream impractical. These are: 1) the dredge plant would have to be demobilized and remobilized upstream; 2) there is no way that a barge can go through the Quincy Avenue bridge and, therefore, material would have to be trucked across the road to the barge or disposed of on land. There is no land disposal site available.

Plans A and B would only involve dredging intertidal areas, thereby minimizing use of natural resources and intertidal areas. Dredging would occur in the fall to avoid disruption of the anadramous fish run.

Plan B is compatible but not necessary for implementation of any local and State plans. Aesthetically, Plan B would contribute as would Plan A. This plan would be acceptable to local interest and is within their monetary constraints.

Plan C. Plan C would increase the existing fleet in the area by 57 vessels. The channel dimensions from Plan C would provide safe navigation. The anchorages would accommodate 57 vessels of an average length of 30 feet. This would assume that the vessels utilize a free swing mooring. Plan C which would involve dredging 170,000 cubic yards would not minimize dredging quantities with benefits of $532,500 and costs of $2,024,500. Plan C provides the best net benefits of the plans. Furthermore, incremental analysis show the anchorages are not economcally justified. Plan C could possibly increase the usage of the facilities on the river to a point where they were overcrowded.

Plan C would involves dredging approximately 6.5 acres of intertidal zone which would destroy valuable natural resources. The dredging could be scheduled to avoid impacting the anadramous fish run.

Because local interest have no plans to expand their shore-based facilities, Plan C might be pressuring for unwanted expansion. Furthermore, the local cost share is in excess of $1 million and is not within the locals ability to pay.

COMPARISON

TRADE OFF ANALYSIS

In comparing the three detailed plans, all three were evaluated against the national objectives, planning objectives and constraints and the evaluation criteria. Table 2 is a detailed system of accounts which evaluates the plan considered.

In terms of the planning objectives all three plans owuld aid navigation and promote maximum utilization of existing facilities. However, in terms of the planning constraints, Plan C is not within the

non-Federal interests ability to pay. Plan C also intails dredging approximately 6 acres of intertidal area. All three plans have benefit cost ratios greater than 1. Incremental analysis of Plan C shows, however, that the two anchorage areas are not economically justified.

TABLE 2-9

System of Accounts

	PLAN A	PLAN B	PLAN C
Structures-Federal	Dredging a channel 8000 feet long 6 feet deep at MLW	Dredging a channel 8600 feet long 6 feet deep at MLW	Dredging a channel 8000 feet long 6 feet deep at MLW and 8 acres of anchorage area
Structures-Local	None	Same as A	Same as A
NATIONAL ECONOMIC DEVELOPMENT			
IMPLEMENTATION COSTS	$400,000.00	$534,000	$2,024,500
Federal	200,000.00	267,000	1,012,250
Non-Federal	200,000.00	267,000	1,012,250
Average Annual Benefits	339,100.00	339,100	509,500
Reduction in Damages	23,000.00	23,000	23,000
TOTAL	$362,100.00	362,100	532,500
Average Annual Costs			
Interest and Amortization	$ 30,300	$ 40,500	$ 153,600
Maintenance	16,000	21,000	80,900
TOTAL	$ 46,300	$ 61,500	$ 234,500
Benefit-Cost Ratio	7.8:1	5.8:1	2.2:1
Net Benefits			--

ENVIRONMENTAL QUALITY			
WATER QUALITY			
Turbidity at Dredge Site	Yes	Yes	Yes
Effluent Discharge at Dredge Site	No	No	No
Disposal Promotes Leaching of Effluent into Tidal Lands	No	No	No
Breakwater Interferes with Tidal Currents			
Breakwater Decreases Water Quality			
AIR QUALITY			
Increased Fuel Emissions from Vessels and Vehicles	No	No	Yes
Short Term Dust Conditions at Disposal Site	No	No	No
Dust and Noise at Dredging Area			
Dust and Noise at Off-Shore Construction Sites			
Short Term Marine Odor During Dredging Operations	Yes	Yes	Yes
LAND USE (Present)			
Wetlands Lost	No	No	Yes
Commercial Land Use Disrupted	No	No	No
Residential Land Lost	No	No	No
Sufficient Land for Land disposal	-	-	-
Recreational Land Lost	No	No	No
Wildlife Area Lost	No	No	No
PLANTS			
Terrestrial Vegetation Destroyed	No	No	No
Aquatic Vegetation Destroyed	Yes	Yes	Yes

ANIMALS			
Wildlife Displaced	No	No	No
Wildlife Destroyed	No	No	No
Benthic Fauna Destroyed	Yes	Yes	Yes
Temporary Disruption of Fish Habitat	Yes	Yes	Yes
Permanent Disruption of Fish Habit	No	No	No
VISUAL APPEARANCE			
Loss of Aesthetics	No	No	No
Support Construction Required	No	Maybe	No
Industrial/Commercial Development Encouraged	No	No	No
Land filling Necesary	No	No	No
Increase Vehicle Activity in Existing Port Area	Yes	Yes	Yes
Increase Vehicle Activity in Other Area	No	No	No
Archeological and Historical Value Lost	No	No	No
<u>SOCIAL WELL BEING</u>			
Encourages a Diversified Base through New Industrial Development	No	No	No
Decreases Risk of Vessel Collision	Yes	Yes	Yes
Short Term Disruption of Vehicular Traffic	No	No	No
Concentration of Heavy Equiment	No	No	No
Increases Potential Hazart to Health and Safety During Construction			
Overall Navigation Project Will Require Local Labor	Yes	Yes	Yes
Related Development of Facilities Will Require Local Labor	No	No	No

Industrial, Commercial, and Residential Relocation Necessary	No	No	No
Disrupts Commercial Business Activities	No	No	No
Disrupts Recreational Activities	No	No	NO
Related commercial Development Will Increase Tax Revenues	No	No	No
Large Local Investment Required to Develop Related Commercial Facilities	No	No	No
Project Makes Maximum Use of Existing Commercial Facilities	Yes	Yes	Yes
Disrupts or Overextends Police and Fire Protection	No	No	No
REGIONAL DEVELOPMENT			
Supports Industrial and Commercial Growth	No	No	No
Provides Service and Maintenance Facilities	No	No	No
Majority of Construction Labor for Basic Project Hired Locally	No	No	No
Construction Expenses Would Increase Local Income Through Secondary and Induced Economic Activity	Yes	Yes	Yes
Non-Federal Government Funds Required for Implementation of Portion Project	Yes	Yes	Yes
Disrupts Commercial Production During Implementation	No	No	No

OTHER EVALUATED CRITERIA			
Minimizes Adverse Social Impacts	Yes	Yes	No
Navigation Benefits Exceed Costs	Yes	Yes	No
Plan is Acceptable to Town Planners	Yes	Yes	No
Plan is Acceptable to State Agencies	Yes	Yes	No
Plan is Acceptable to Other Federal Agencies	Yes	Yes	No
Plan is Acceptable to Private Concerns	Yes	Yes	No
Plan Compliments Redevelopment Plans of the Town	Yes	Yes	No

SECTION D

SELECTING A PLAN

SELECTION RATIONAL

Selection of a plan of improvement was based on a comparative evaluation of the alternative plans. Table 2, Systems of Accounts shows this evaluation.

NATIONAL ECONOMIC DEVELOPMENT PLAN (NED)

The National Economic Development plan is based on the plan which maximizes the net benefits. Plan A with net benefits of $316,000 is the NED plan.

ENVIRONMENTAL QUALITY PLAN

Plan A is the plan which has the least impact upon the environment. This plan also has the most positive impacts interims of reduced siltation, which would cause decreased damage to the tidal flats.

The Selected Plan

Plan A is the selected plan of improvement.

Plan Description

Plan A would provide an 8000 foot long channel, with a width varying from 100 to 60 feet, dredged to a depth of 6 feet mlw. Table 2-1 shows the pertinent data of the selected plan.

TABLE 2-2

Channel length (feet)	8,000
Channel width (feet)	60-100
Channel depth (feet) MLW	6
Side slopes	1 on 3
Dredge Quantities (cubic yards)	31,000
Maintenance, average annual (cubic yards)	

General Impacts Of Construction

The construction of the proposed plan will have both temporary and long-term effects on the environment. Short-term effects include air pollution, and mild water degradation due to the dredging equipment. Long-term effects are few and primarily relate to potential problems at the disposal site. These are further discussed in Appendix 6.

Water Quality

The existing water quality on the Weymouth Fore River will not be significantly impacted due to construction. During the actual dredging operation the suspended solids and turbidity will be increased, however these effects will be short term.

Air Quality

The dredging operation will have little if any effect on the air quality around the river.

Other Impacts

During the dredg_ operation the noise levels on the river will be slightly increased. Dredging only 16 hours per day 5 days a week will limit any noise problems.

Harbor Improvements And Evaluated Accomplishments

Construction of Plan A would provide a safe navigable channel on the river. The removal of 31,000 cubic yards of relatively polluted material would aid in pollution clean up efforts, and add to the aesthetics at the site.

The project would provide $316,000 of quantifiable net benefits to the area. Other accomplishments not quantifiable are the potential improvement to the anadramous fish run and the clam flats because of the removal of the polluted material.

Dredging of the channel would allow for maximum utillization of the area by the existing recreational fleet. This would help the regional problems that the areas recreational fleet presently has by not exaserbating the problem.

Appendix 3

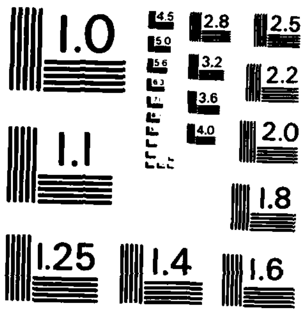
Public Views and Responses

PUBLIC VIEWS AND RESPONSES

Table of Contents

AD-A122 889 WEYMOUTH FORE RIVER WEYMOUTH BRAINTREE MASSACHUSETTS SMALL NAVIGATION PRO..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV FEB 81 2/3

UNCLASSIFIED F/G 13/2 NL



MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS-1963-A

Table of Contents
(continued)

THE
TOWN OF
BRAINTREE

OFFICE OF SELECTMEN

TELEPHONE
843-0163

ONE JOHN FITZGERALD KENNEDY MEMORIAL DRIVE
BRAINTREE, MASSACHUSETTS 02184

February 3, 1976

Division Engineer
New England Division, Corps of Engineers
Department of the Army
424 Trapelo Road
Waltham, Mass. 02154

Dear Sir:

I wish to request formally a survey and engineering study for a dredging project in the Fore River channel, under the provisions of Section 107 of the 1960 River & Harbor Act.

Generally, it is desirable to improve the major access channel from the Fore River Shipyard channel in Braintree and Quincy to the mooring area just beyond the Quincy Avenue (Route 53) bridge in Braintree. The present channel has silted very badly and has low water depth in places of 3' or less. It is anticipated to develop a channel size of 100' in width with a minimum low water depth of 8'.

A locus map in further description of the project is enclosed.

Very truly yours,

Robert R. Sherman
Executive Secretary/
Administrator

RRS:nb
enc.
cc: Robert F. Daylor,
Board of Selectmen, Weymouth

BOARD OF SELECTMEN
B. JOSEPH FITZSIMMONS, JR., CHAIRMAN
GEORGE T. DOWD, JR., VICE CHAIRMAN & CLERK
WILLIAM E. DURGIN
WILLIAM G. RENNIE, JR.
WILLIAM B. BARRY, JR.

RUTH E. FRAZIER
EXECUTIVE SECRETARY

335-2000

1622
Three Hundred and Fifty-Three Years of Planned Progress

East Weymouth, Mass. 02189

THE TOWN OF WEYMOUTH
MASSACHUSETTS

February 23, 1977

Mr. Anthony Gorone
Army Corps of Engineers
New England Division of Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Sir:

At an official meeting of the Board of Selectmen held on Tuesday evening, February 22, 1977 it was unanimously voted:

> "to approve an engineering survey on Fore River dredging as per letter dated January 6, 1977. Incorporated in vote is that Board is <u>not</u> willing to commit any financial backing either at present time nor in the future."

We shall await your comments in regards to this matter.

Very truly yours,

TOWN OF WEYMOUTH
BOARD OF SELECTMEN

B. Joseph Fitzsimmons Jr

B. Joseph Fitzsimmons, Jr.
Chairman

BJF/fc

THE
TOWN OF
BRAINTREE

OFFICE OF SELECTMEN

TELEPHONE
843-0163

ONE JOHN FITZGERALD KENNEDY MEMORIAL DRIVE
BRAINTREE, MASSACHUSETTS 02184

February 28, 1977

Mr. Anthony Garone
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02154

Dear Mr. Garone:

This letter will indicate Braintree's extreme interest in moving forward with the channel dredging project for the Weymouth Fore River in Braintree and Weymouth.

As an indication of good faith, the Board of Selectmen has sponsored an article in which funds are requested as the town's share of the proposal.

The need here is evidenced by the fact that no dredging has been implemented for over twenty years.

Very truly yours,

Robert R. Sherman

Robert R. Sherman
Executive Secretary/
Administrator

RRS:pb
cc: Robert F. Daylor

PAUL GUZZI

Secretary of the Commonwealth

The Commonwealth of Massachusetts

Office of the Secretary

Massachusetts Historical Commission

294 Washington Street Boston, Massachusetts 02108

(617) 727-8470

July 27, 1978

Richard F. Norton
Gale Engineering Company, Inc.
8 Washington Place
Braintree, MA 02184

Re: U.S. Army Corps, Small Boat Navigation Project, Weymouth
JN 2126

Dear Mr. Norton:

The Massachusetts Historical Commission has reviewed the information you supplied regarding the Small Boat Navigation Project in Weymouth. MHC feels that the project is unlikely to affect significant prehistoric or historic resources.

If we can be of further assistance, please contact Valerie Talmage, Staff Archaeologist.

Sincerely,

Patricia L. Weslowski

Patricia L. Weslowski
State Historic Preservation Officer
Acting Executive Director
Massachusetts Historical Commission

PLW/VT/lh

C

7

BOSTON EDISON COMPANY
225 FRANKLIN STREET
BOSTON, MASSACHUSETTS 02110

August 14, 1978

Mr. Richard F. Norton
Gale Engineering Company
8 Washington Place
Braintree, Massachusetts 02184

Dear Mr. Norton:

Your verbal request for a determination by Edison, of the proposals presented verbally to Mr. J. W. Mich of this department have been carefully reviewed and considered.

We regret to inform you, that the placing of the dredged material on Edison's property in Weymouth, or the use of Edison's Edgar Station property for transfering the material for trucking must be denied. The placement of 100,000$\pm$ cubic yards of dredged material upon our land in Weymouth, could adversely affect our future use for this land for transmission lines, or substation use.

We concur with Mr. Mich's assessment of the danger involved in the loading of and movement of trucks through the station property. Not only is there a possibility of an accident creating a power outage, but the extensive underground facilities could be damaged by the incessant movement of the trucks.

Very truly yours,

C B Damrell by
CWJ Ryan

C. B. Damrell, Superintendent
Engineering & Construction Dept.

JWM/CBD/dm

*cc: Mr. F. M. Lee
Mr. J. W. Cox
Mr. F. J. Gottlich

3-6

NEDPL-C 25 July 1979

Mr. Carl Johnson
Chairman, Board of Selectmen
Town of Braintree
Town Hall
Braintree, MA 02184

Dear Mr. Johnson:

Regretfully, this office is informing you of decisions concerning local cost sharing responsibilities which are necessary to continue our planning project for channel improvements on the Weymouth Fore River, Weymouth-Braintree, Massachusetts. This planning effort used the provisions of Section 107 of the 1960 River and Harbor Act, as amended.

In a recent policy decision handed down by the Chief of Engineers, specific guidelines were detailed for Corps participation in projects previously dredged by the Commonwealth of Massachusetts.

With regard to the current proposed small project at the Weymouth Fore River, in order for us to proceed, the following conditions must be met:

a. The "without project" condition is the original Commonwealth project, if maintained.

b. Any benefits accruing to the federal project must be incremental to benefits attributable to the Commonwealth project.

c. As an item of local cooperation, the project sponsor would be required to dredge the existing channel to the original Commonwealth project dimensions, in addition to the normal cost sharing for the federal improvement. The cost of the rehabilitation work would not be reflected in the economic analysis.

d. Maintenance of the project would be a federal responsibility.

If conditions (a) and (b) above are followed, it appears possible that the project would be economically justified, incrementally. However, to fulfill condition (c), non-federal interests must cost share 90.5 percent of the first cost of construction. The current estimated first cost of the proposed project is $359,100. The estimated local share of this is $324,955.

In light of this decision, this office would like to discuss these new cost sharing constraints with you before continuing with the study process. We will be in touch with you in the near future to arrange a meeting.

We are truly sorry for any inconvenience we may have caused your community.

Sincerely yours,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

cc: Mr. Robert D. Sherman
Executive Secretary
Town of Braintree
John Fitzgerald Kennedy Drive
Braintree, MA 02184

Same letter to: Mr. Edward Owens, Jr.
Chairman, Board of Selectmen
Town of Weymouth
Town Hall
Weymouth, MA 02189

Coastal Development Branch
Reading File
Planning Division File

Braintree Yacht Club

6 GORDON ROAD
BRAINTREE, MASS. 02184

P. O. BOX 51
WEYMOUTH, MASS. 02188

August 23, 1979

Mr. Carl R. Johnson, 3rd
Chairman, Board of Selectmen
Town of Braintree
Town Hall
Braintree, Massachusetts 02184

Subject: FORE RIVER DREDGING PROJECT

Dear Mr. Johnson:

In accordance with the verbal presentation relative to the Fore River dredging project made to the Board of Selectmen August 20th, 1979, this letter will serve as written confirmation of intent on behalf of the Braintree and Metropolitan Yacht Clubs, hereafter referred to as private interests. It is the intent of the private interests to provide to the Town of Braintree the sum of $22,000.

This sum of money represents an increase of $12,000 in private interest funding.

A similar amount of money will be forwarded to the Town of Weymouth, this is in keeping with the originally agreed appropriation percentage.

For the record, the current funding formula is as follows:

A.	State Division of Waterways	$220,000.00
B.	Town of Braintree	30,000.00
C.	Town of Weymouth	30,000.00
D.	Private Interest	44,000.00
E.	Corps of Engineers	35,000.00

Respectfully submitted,

Ed DeCoste
Ed DeCoste
Commodore
Braintree Yacht Club

Richard Kublin
Richard Kublin
Commodore
Metropolitan Yacht Club

C

mt

THE
TOWN OF
BRAINTREE

OFFICE OF SELECTMEN

TELEPHONE
848-1870

ONE JOHN FITZGERALD KENNEDY MEMORIAL DRIVE
BRAINTREE, MASSACHUSETTS 02184

August 24, 1979

Max B. Scheider, Colonel
Corps of Engineers
Division Engineer
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Scheider:

During the regular Selectmen's Meeting of August 20, a representative of your Office along with Ed Massachelli of the Braintree Yacht Club and Robert Daylor of the Metropolitan Yacht Club, appeared to explain the recent policy decision by the Chief of Engineers relating to the channel improvements in the Weymouth Fore River in which the Towns of Weymouth and Braintree are participating.

The Selectmen voted unanimously to urge the continuation of this study process since the cost/benefit ratios for all involved are most favorable.

Very truly yours,

Robert R. Sherman
Executive Secretary/Administrator

RRS:egd

Braintree Park Department

OFF UNION STREET
BRAINTREE, MASSACHUSETTS 02184
843-8842 843-0739

GUY M. GREY, Supt.
Parks & Playgrounds

WILLIAM D. HEDLUND, Dir.
Youth Services and Recreation

BOARD OF PARKS AND PLAYGROUNDS COMMISSION

JOHN J. HENNESSY
Chairman.

SHEILA D. ROACH
Vice Chairman

THEODORE W. BROWNE

H. FREDERICK HERGET

JAMES E. SULLIVAN

WILLIAM A. VARROSO

EDWARD R. WYNOT

"PARKS and PROGRAMS for PEOPLE"

January 23,1980

Col. Max B. Scheider
Division Engineer
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusets 02154

RE: 2/7/80 Hearing @ Braintree High School on Weymouth Fore River Dredging Project and Related Environmental Impact Statement

Dear Col. Scheider:

The Braintree Board of Parks and Playgrounds Commission fully support and recognize the need for dredging of the Weymouth Fore River as proposed from approximately the main shipping terminal channel in Quincy to the Quincy Avenue Bridge in Weymouth Landing, Braintree. We are interested in seeing this project completed because of the fact that we operate a ten week bathing beach on this river during the summertime and we recognize the recreational boating activity annually in the river as well. The water quality of this river has deteriorated during the past several years and we hope that dredging will improve this condition measurably.

The Board when contacted by representatives of the Braintree Yacht Club and even at subsequent public meetings thereafter have made but one stipulation to their enthusiastic support for this project and that is that any dredging or any activity related to this project that would in any way worsen swimming conditions at Smith Beach on this river should be prevented at all costs. We operate our bathing program from the last week in June through Labor Day each year. We ask your full cooperation in this request assuring the public of Braintree that dredging which may have an adverse effect on daily swimming conditions will be prevented during this ten week period.

Thank you for your allowing us the opportunity to present this request before you prior to this hearing scheduled for next month.

Very truly yours,
BOARD OF PARKS AND PLAYGROUNDS COMMISSION

J. J. Hennessy

John J. Hennessy, Chairman

cc:
Conservation Commission

THE TOWN OF BRAINTREE
CONSERVATION COMMISSION
ONE JOHN FITZGERALD KENNEDY MEMORIAL DRIVE
BRAINTREE, MASSACHUSETTS 02184

February 13, 1980

Colonel Max B. Scheider
Corps of Engineers
424 Trapelo Road
Waltham, Ma. 02154

Dear Colonel Scheider:

The Town of Braintree welcomes the dredging project in the Fore River. We foresee many years of silt free harbor recreation.

Town rules and regulations have been adopted in order to relieve erosion during the construction process of town development, and Braintree now has strict regulations regarding erosion and runoff created by the build environment. With the enforcement of these stricter guidelines regarding erosion, the need for dredging downriver should be slowed considerably.

We have also applied for CZM funds to study the Monatiquot River siltation and pollution sources. We should hear from CZM regarding this Coastal Zone Management Study Grant of $16,000 matched by in-kind and local funds worth $4,000 by the end of April, 1980. Enclosed is the cover page of this Monatiquot River Study Grant Proposal. We will keep the Corps of Engineers posted on the progress of this study.

Sincerely yours,

Edith A. Gillis

Edith A. Gillis,
planning assistant

enclosure

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Environmental & Technical Services Division
Environmental Assessment Branch
7 Pleasant Street
Gloucester, Massachusetts 01930

March 5, 1980

Col. Max B. Scheider
Division Engineer
Department of the Army
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Scheider:

We have reviewed the bioassay study results and the summary of environmental concerns prepared for the proposed Weymouth Fore River Water Improvement Project and offer the following comments for your consideration.

Several of the control experiments in the bioassay tests did not meet the criterion (mortality = 10% or less) specified in the EPA/CE implementation manual for Section 103 of Public Law 92-532. Consequently, these data must be discarded and additional tests conducted. Specifically, the following control experiments had mortality levels in excess of 10%: the solid phase bioassay for Neomysis americana (Table 3-2) and the suspended particulate phase bioassays for Acartia clausi (Tables B-16, B-17, B-18). Discussion of the results of treatment bioassays run in conjunction with the controls referenced above would be of no value because the controls cannot be considered for the reason given.

Results of the liquid phase bioassay for A. clausi indicated mortality was significantly greater in the test cases than in the corresponding controls for all three sites. This indicates that a potential for significant adverse impacts upon zooplankters exists. However, the dilution curve (Figure 3.1) indicates that conditions at the disposal site would not approach the LC_{50} at any time.

Although one of the replicates for the bioassay using 100% of the elutriate from site 2 for N. americana was not run for 96 hours, the remaining two replicates indicate that mortality was not significantly greater than in the control. We do not recommend that an additional replicate be run.

Bulk sediment analysis data presented in Table 1 of the summary of environmental concerns do not include information for PCBs. Mercury, lead, zine, and vanadium are present in high concentrations (Class III) in at least some sediments. If bulk sediment analyses are available for the individual sampling sites, we would like to see them presented for each site separately. If pollutants are concentrated at certain sites, those areas could be dredged first and more polluted sediments could be capped by those containing lower concentrations of pollutants.

We shall defer our final recommendation until the additional data becomes available. If you have questions concerning our comments, please contact Charles Karnella (FTS 837-9338) of my staff.

Sincerely,

Ruth Rehfus

Ruth Rehfus
Acting Branch Chief

10 MAR 1980

NOAA

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

COASTAL ZONE
MANAGEMENT

March 18, 1980

Colonel Max B. Scheider
Division Engineer
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02154

Dear Colonel Scheider:

Iam writing regarding the proposed navigation improvement project for Weymouth-Fore River, Braintree and Weymouth, Massachusetts. Included are comments pertaining to the study conducted under the authority of Section 107 of the 1960 River and Harbor Act, as amended.

As proposed, the project will provide an 8,000 foot channel with a depth of 6 feet mean low water. In addition, 31,000 cubic yards of silt-clay materials will be dredged by clamshell and disposed of at the interim designated disposal site located 42° 25'42" N and 70° 34'00" W.

In regards to the problems associated with siltation and its impacts on shellfish beds, while siltation may damage the beds, dredging will remove and destroy the beds. To minimize impacts, the Corps should work with the Division of Marine Fisheries in identifying the location of the shellfish beds. And due to the nature of the sediments (Class III, Type C per Massachusetts Division of Water Pollution Control, Regulations for Water Quality Certification for Dredging, Dredged Material Disposal and Filling in Waters of the Commonwealth) it is recommended by this office that silt curtains be used during the dredging operation.

In discussing the disposal alternatives, mention is made of investigating the feasibility of artificial habitat creation. This office requests that those areas considered be delineated. The reasons for not utilizing these sites should also be outlined.

Aspects of the navigation improvement project have been incorrectly described in this study. Clarification of these aspects is given below.

The study suggests that channel improvements will aid both swimmers and recreational boaters by reducing confrontations between each group. It is unreasonable to assume that a deeper channel will solve this problem, since it is most probable that swimmers will be attracted by the new, deeper channel. Therefore, the Corps and the project proponents should actively pursue delineating the channel and restricting swimmers. Channel markers should be considered.

In discussing the shoaling problem, the narrative gives the impression that shoaling and siltation will be solved by dredging. While dredging will remove the shoals, it will do so only for a relatively short time. It will neither solve the siltation problem nor the damage and inconvenience caused by flooding. Therefore, there is a need to investigate the causes and sources of siltation.

The fact that "cleaner" sediments may be uncovered has not been substantiated. If in fact cleaner sediments are found, a healthier benthic community may be established, but only temporarily. Neither the environmental quality of the whole river system will improve, nor will the sources of pollution be stopped. Therefore, it is most likely the dredged area will again become polluted. While it is not within the scope of this project, unless sources of pollution are identified and eliminated, removal of polluted sediments will provide only a temporary improvement.

There is no discussion of the need for maintenance dredging.

This office is pleased to have the opportunity to comment on this project prior to any formal review. We will, of course, review any final plans for consistency with our policies and appreciate being kept up-to-date on the progress of the report.

Sincerely,

Bruce McIntyre

for Edward J. Reilly
Assistant Secretary

EJR/RT:dc

cc: Leigh Bridges, DMF
Robert Ingram, DWPC
Sterling Wall, DEQE
Lydia Wood, Corps of Engineers

UNITED ST'.1ES ENVIRONMENTAL PROTECTION AGENCY
REGION I

J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203

March 25, 1980

Colonel Max B. Scheider
Division Engineer
Department of the Army
Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

Re: Weymouth-Fore River Navigation Improvement Project
EPA #7899

Dear Colonel Scheider:

We have reviewed the bioassay study results and the Summary of Environmental Concerns prepared for the proposed Weymouth-Fore River Navigation Improvement Project, Braintree and Weymouth, Massachusetts. The following questions and comments are for our continuing coordination and review of this project.

We would like a diagram illustrating the locations of the sampling stations which were used to provide the Bulk Sediment Analysis and Elutriate test (Table 1 and 2 of the Summary of Environmental Concerns) for the 31,000 cubic yards of silty-clay sediments which would be removed by clam shell dredge and disposed of at the "Boston Foul Area."

We would like site specific results of these sediments chemical composition rather than the results shown on Table 1 which states lowest, highest, and mean values. We would like to know the PCB value as well (none were provided), and obtain the grain size distribution curves, if they exist for these sampling sites. This information will help us fully evaluate the material to be dredged and disposed of at the "Foul Area."

There were some errors in reporting the units of measurement for the Elutriate Test data, (Table 2 of the Summary of Environmental Concerns). Please provide us with a corrected version of this data.

We would like to have a Bulk Sediment Analysis provided for the Boston Foul Area, including PCB and DDT determinations and ambient water quality data for the dumpsite for PCB. This data is necessary to determine if the dredged material will be increasing the availability of PCB and DDT for bioaccumulation at the disposal site. We are aware that the Corps operated DAMOS program may be addressing this availability question and we believe that this type of intra-agency coordination is part of the planning associated with dredging projects. In order to develop meaningful data on the PCB and DDT characteristics of the disposal site extensive sampling may be required. We recognize this and suggest that the matter be discussed further.

Section 2.3 of the bioassay study states reference sediment was obtained from the intertidal zone at Third Beach, Middletown, Rhode Island. Please provide us with the sedimentological characteristics of the reference sediment. Please note in terms of testing guidance, although the implementation manual does not state so, we believe reference sediments should come from subtidal areas rather than intertidal zones.

We would like explanations regarding control group mortality in the following bioassay test phases.

Control group, Solid Phase:

1. Mercenaria mercenaria, mortality 10 of 100.

2. Nereis virens, mortality 5 of 100.

Control group, Suspended particulate phase:

All 3 sites Acartia clausi, mortality 4-5 of 30.

Further explanation of these incidences of control group mortality is necessary for us to decide if the test results are reliable for making conclusive judgments on the toxicity of the materials.

Page 5-1 of the bioassay study states mysid shrimp may have escaped out of the baskets and could have gotten siphoned out of the aquaria during the water renewal process. Page 5-2 of the study states "it was observed that some deformation and collapsing of these cylinders occurred in the treatment tanks, even in the liquid phase tests. These changes in the basket integrity in some cases allowed mysids to escape into the aquaria where predation by other species could occur." Page 5-2 also states that nitex basket mesh became clogged with fine sediment and may have resulted in mysids having lower dissolved oxygen concentrations in the basket. In terms of guidance for future bioassay testing, we believe changes should be made in the nitex screen design and water renewal procedures to eliminate these causes of mysid mortality. Page 2-3 of the Bioassay study states nitex baskets were 3cm x 10cm. Page 2-5 states nitex screens were 3cm x 30cm. We would like a clarification as to the size of these screens used for mysid shrimp. Were two different type screens utilized?

We believe a bioaccumulation test should be performed on representative samples of sediments to be dredged. The test should be performed at 20°C if acclimation of the organisms poses no problems - causes no mortality and does not shock the test organisms. Bioassays and bioaccumulation tests should not be performed at 5°C since the test organisms will not be active at such a low temperature.

If you have any questions, please contact Ed Reiner of my staff at 617-223-5061.

Sincerely,

Allen J. Ikalainen

Allen J. Ikalainen
Chief, Special Permits Development Section

cc: USF&WS, Concord, NH
NMFS, Gloucester, MA

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
P.O. Box 1518
Concord, New Hampshire 03301

APR 01 1980

Colonel William E. Hodgson
Deputy Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Hodgson:

This is our report concerning your study of navigation improvement for the Weymouth Fore River in Weymouth and Braintree, Massachusetts. The proposed project will consist of a channel 8,000 feet long and varying from 60 to 100 feet wide.

Weymouth Fore River is an arm of Hingham Bay which is a part of Boston Harbor. Tidal marshes and flats still support softshell clams, clamworms, blue mussels and other benthic species even though productivity has been severely affected by pollution.

Dredging a channel is not expected to adversely impact the fish species in the project area including anadromous rainbow smelt. The planned work will take place in the fall, thereby avoiding both the peak season of biological production and the anadromous fish spawning run. Temporary adverse impacts such as the dispersal of sediment during dredging, and more long lasting impacts from the disturbance of polluted materials, are expected to occur.

The most important environmental problem associated with this project is the polluted nature of the 31,000 cubic yards of materials to be removed by project dredging, additional maintenance dredging and the potential disturbance of bottom materials by increased numbers of boats.

The Monatiquot River enters the estuary just upstream from the area to be dredged. This stream probably contributed large amounts of sediment to the project area as a result of erosion at upstream construction sites. If the upstream sediment problem is not reduced, future maintenance dredging will need to be unnecessarily frequent.

The tendency of urban watersheds to carry high sediment loads is recognized in the Tenth Annual Report of the Council of Environmental Quality, "As shown by these data, modification of watersheds away from their natural

condition toward the kind of watersheds found in urban areas, results in increased flushing of suspended and dissolved substances including nutrients and pollutants."[1] Therefore, we recommend that minimizing erosion by stabilizing upstream problem areas be included as a condition for Federal participation. This would reduce the cost of future maintenance, reduce the problem of spoil deposition, and improve environmental conditions in the Fore River.

Paragraph 14 on page 4 of the "Summary of Economic, Social, and Cultural Resources" states that shoaling will continue without the project. Incorporating the erosion control in upstream areas as a part of the project would seem to be the only way shoaling can be reduced with the project. Your project report should include information on previous channel dredging, to indicate future maintenance dredging and specific plans for disposal of maintenance spoils.

The presence of PCB's in the substrate indicates both the existence of this material and its potential for redistribution from the spoil site, whether it is offshore or at an upland site. On February 12, 1980, personnel from the Fish and Wildlife Service, National Marine Fisheries Service, Environmental Protection Agency, Corps of Engineers, and the Massachusetts Office of Coastal Zone Management agreed that samples from sites in the proposed channel area should be subjected to bioaccumulation tests. It was also our concern that the PCB's and heavy metals should not be redistributed into the marine environment.

Results of the solid phase bioassay are confusing and misleading. The 88% survival of mysid shrimp in the control sediment was low. According to the Implementation Manual the test should be repeated if survival in the reference sediment is 90% or less. Using the control (culture) sediment to justify the bioassay is not valid. Reference sediment should not come from an intertidal site but from the vicinity of the disposal site. The bulk sediment analysis should include PCB's and the elutriate test data for PCB's should be correctly identified in Table 2 of the "Summary of Environmental Concerns." We are concerned that 5°C temperature maintained during the tests is too low to obtain results that would be representative of typical natural conditions in the vicinity of the disposal site. Such cold temperatures probably occur far less than half the year. A higher temperature should be used to simulate more typical conditions and promote a higher metabolic rate during the tests. The description of problems encountered during the testing indicate that some procedural and equipment modifications would be desirable. For example, the clogging of the nitex mesh could have caused *mysid* mortality.

Your report should describe long-term impacts of offshore disposal. These impacts are either omitted or too briefly stated. The impacts of continued disposal of contaminated materials into the sea should be

[1]Council on Environmental Quality. December 1979. Environmental Quality - 1979, Tenth Annual Report, p. 439.

discussed more thoroughly. A recent article by Robert A. Murchelano of the National Marine Fisheries Service discusses possible, though poorly defined at this time, relationships between degraded habitat and diseases of fish and shellfish. He states that "There is increasing evidence that poor environmental quality causes disease and predisposes marine species to diseases to which they are normally susceptible."[2] The contribution of contaminated sediments to the "poor environmental quality" could be substantial.

We recommend that alternatives other than various dredging proposals be considered. One alternate is the use of shore based rack storage units for the smaller boats. This could reduce channel dredging and possibly some anchorage dredging if the storage sites are located near deeper water.

We plan to await the results of bioaccumulation tests before making final recommendations. However, our most probable position will be to recommend that the material be deposited in a sealed containment site to prevent contaminants from entering the environment, even though construction of a containment site could delay this project. Your report should include strong encouragement for development of a spoil management plan in the Boston area, including sites for containment of polluted spoil.

Please forward the results of the further studies when they are completed.

Sincerely yours,

Gordon E. Beckett

Gordon E. Beckett
Supervisor

[2] Murchelano, Robert A. 1980. Environmental Quality and the Diseases of Fish and Shellfish, Maritimes, February 1980, Graduate School of Oceanography, University of Rhode Island, pp. 7-10.

NEDPL-C 4 April 1980

Mr. Edward J. Reilly
Director, Coastal Zone Management
100 Cambridge Street
Boston, MA 02202

Dear Mr. Reilly:

In response to your comments on the Weymouth-Fore River improvement project dated 18 March 1980, I would like to answer some of your questions.

After viewing the area and analyzing the existing data on shellfish in the area, we have planned our channel so that it is not cutting through any shellfish beds.

The area known as the Mill Cove tidal flat was looked at for its marsh creation potential. The area is not acceptable because:

1. By raising the elevation of the tidal flats, the tidal inundation of the area would not be sufficient to support a good variety of marsh grasses. Some high marsh grasses could be sustained, however, low marsh grasses would not be productive without daily tidal changes.

2. Tidal flats are by themselves invaluable natural resources and as such should be protected.

3. The cost of bulkheading to retain the material is prohibitive.

Presently the boats tend to run up along the Braintree shoreline closer than the channel would allow. By making the deepest water in the channel, the trend would be for the boats to keep in the deepest water hence further away from swimmers.

Ms. Wood/mc/549

NEDPL-C 4 April 1980
Mr. Edward J. Reilly

In general, siltation on the river is caused by two factors:

1. Normal riverine sedimentation processes.

2. Sedimentation by excessive stream bank development.

Since 1954 when the river was previously dredged, approximately 33,000 cubic yards of material have silted into the river. This is approximately 1,400 cubic yards per year. Because the extensive upstream development which has occurred during the last couple of decades is slowing down, it is reasonable to assume that a portion of the siltation in the river will decrease. In any case, a maximum future siltation rate would be nearly equal to the present tate. This would indicate a need for maintenance every 25 years.

It is our understanding that your office has awarded a planning grant to the town to study the causes and sources of siltation along the river.

If you have any further questions at this time, please feel free to contact me or Ms. Lydia Wood of my staff.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

cc: Coastal Dev. Br.
Reading File
Planning Div. File

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDPL-C

10 April 1980

Mr. Allen J. Ikalainen
Chief, Special Permits Development Section
United States Environmental Protection Agency
Region 1
Boston, Massachusetts 02202

Dear Mr. Ikalainen:

This is in response to your letter of 25 March 1980 on the Weymouth-Fore River Navigation Improvement Project.

First, I would like to explain the purpose of a Summary of Environmental Concerns. The Summary is only meant to highlight major issues that an Assessment or an EIS might address at a future date. Through review of the Summary, agencies such as yours and the public can suggest other issues that should or could be addressed or suggest deletions of issues found in the Summary that are not germane to the project.

The diagram illustrating the sampling locations has been included in the Draft Detailed Project Report, as well as the site specific chemical analysis. Grain size analysis for some of the samples is also included in Appendix 6. There is no available data for PCB's in the sediments of the Fore River.

In terms of the Foul area disposal site, there is only limited data available. Bulk chemical analysis is available through the DAMOS program, excluding PCB's and DDT's. Further data is available in a report by the New England Aquarium entitled, "A Study of the Boston Foul Area." This report has PCB data on the sediments found at the Foul Area. This office has developed a preliminary plan for sampling the ambient water quality data for the dump site for PCB's. Because this data will impact other dredging projects and the present lack of funding, we agree, further discussion is necessary.

As for the bioassay study, the sediments used for the control/reference material was a fine-grain sand. We agree that a reference sediment should be taken from a subtidal area; however, at the time, if you remember, no distinction was made between reference and control sediments. We now know that a control sediment is used to insure the quality of the test being run, whereas the reference sediment reflects the condition of the disposal site as if disposal had never taken place there. Since the bioassay test used sand as a reference/control material and since sand usually has few pollutants in it, we believe the test was conservative on the environmental side. All future tests will be conducted with reference and control sediments.

It is not unusual to have mortalities in a control test. There could be many reasons for the deaths of organisms, e.g., disease, age, or rough handlings. However, the mortalities did not exceed the 10 percent limit set in the manual.

In terms of the nitex baskets, this procedure has been changed. The correct mesh size is 3cm x 30cm. It is agreed that any further testing should be performed at 20°C and not 5°C.

If you have any further questions at this time, please feel free to contact me or Ms. Lydia Wood of my staff at 894-2400, extension 549.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION. CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM. MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:
NEDPL-C

18 April 1980

Mr. Gordon E. Beckett
Supervisor
United States Department of the Interior
Fish and Wildlife Service
P.O. Box 1518
Concord, New Hampshire 03301

Dear Mr. Beckett:

In response to your letter dated 1 April 1980 concerning the Weymouth-Fore River Navigation Improvement Project, I would like to clarify a few points.

First, I would like to explain the purpose of a Summary of Environmental Concerns. The Summary is only meant to highlight major issues that an Assessment or an EIS might address at a future date. Through review of the Summary, agencies such as yours and the public can suggest other issues that should or could be addressed or suggest deletions or issues found in the Summary that are not germane to the project.

Next, in Paragraph 4, Page 1, you discuss the potential disturbance of bottom materials by increased numbers of boats. The existing fleet of boats in the Weymouth Fore River is 271 vessels. The plan of improvement that has been proposed was chosen for several reasons, one of which being that the communities did not wish to see any expansion of the fleet. Therefore, there will be no increased numbers of boats. Furthermore, the disturbance of bottom materials is greatly increased when vessels run aground or come too close to the bottom. With a deeper channel, incidents of this type will decrease.

NEDPL-C 18 April 1980
Mr. Gordon E. Beckett

We agree that a major portion of the siltation that has occurred in the river is caused by erosion at upstream development sites. However, in recent years this trend has decreased for two reasons. First, there is little available room left for upstream development on this river; it is a highly urbanized area. Second, what little area remains is protected by regulations within the Commonwealth of Massachusetts to the extent that even if these few areas are developed, the development is conditioned so that increased siltation does not occur.

We have been keeping the Monatiquot River spring spawning run of smelt under observation since 1974. During those six years, we have seen no indication of siltation during the April time period. Incidentally, the Monatiquot River smelt run, with the exception of last year, is probably the most important smelt run on the South Shore. During the years we have observed the run, with the exception of one year, a successful hatch has occurred.

In terms of maintenance, the river was last dredged in 1954. Since then approximately 33,000 cubic yards of material have silted into the river. This is an average of 1,400 cubic yards per year. Assuming that upstream development continued at the same pace it has over the last couple of decades, then maintenance would have to be performed every 25 years. Furthermore, the town of Braintree is presently studying the causes, sources, and solutions of siltation in the river under a grant from the Massachusetts Coastal Zone Management.

As for the bioassay study, the sediments used for the control/reference sediment should be taken from a subtidal area; however, at the time (March 1979), as you remember, no distinction was made between reference and control sediments. We now know that a control sediment is used to insure the quality of the test being run, whereas the reference sediment reflects the conditions of the disposal site as if it had never been used for disposal of dredged material. Since the bioassay test used sand as a control/reference material and since sand usually has few pollutants in it, we believe the test was conservative on the environmental side. All future tests will be conducted with reference and control sediments. As for PCB's, Table 2 of the Summary of Environmental Concerns shows the concentrations in mg/1, but the true designation should have been in ug/1 or one thousandth of what is shown.

NEDPL-C 18 April 1980
Mr. Gordon E. Beckett

On Page 2, Paragraph 4, you state that more information is needed on ocean disposal impacts and that environmental degradation could be causing diseases to those organisms present in the contaminated environment. We believe that the research done to date by Waterways Experiment Station at Vicksburg, Mississippi, has shown that impacts from dredging and disposal are minimal. The Draft Detailed Project Report will discuss this in greater detail.

As for the Murchelano article, a careful reading shows that the article is highly speculative, and as is pointed out on page 10: "To date, all of our evidence of environmentally induced marine disease is circumstantial." Further research may verify the position being presented. However, the point that should be addressed by your agency is whether or not dredging and disposal produce environmental disease. The article only mentions dredged spoils once and never demonstrates that these operations cause a significant problem.

In terms of the alternatives studied, the alternative which included anchorage areas was not recommended, largely due to the town's desire to restrict the size of the fleet to its existing size. None of the anchorage areas presently used on the river are dredged.

Furthermore, in terms of sealed containment of the disposal material, the cost of this would prohibit the project due to non-Federal cost sharing requirements.

Our recent conference on bioassay/bioaccumulation testing brought out some considerations which may have application to this project. We will consult with you and the other agencies prior to undertaking further sampling and analysis.

Finally, the successful bioassay tests run on the Weymouth-Fore River sediments as well as the information that will be presented in the Detailed Project Report indicate that the sediments may not be as harmful as your report suggests. Therefore, we see little value in sealing the sediments. This proposal would only impose an undue hardship upon the taxpayer.

18 April 1980

This office will be sending copies of the draft report including the draft Environmental Assessment to your agency for review in the near future. If you have any further questions at this time, please feel free to contact me or Ms. Lydia Wood of my staff.

Sincerely,

WILLIAM E. HODGSON, JR.
Colonel, Corps of Engineers
Deputy Division Engineer

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Quality Engineering
Division of Land and Water Use
100 Nashua Street, Boston 02114

May 6, 1980

Max B. Scheider, Colonel
Corps of Engineers
Division Engineer
Department of the Army
424 Trapelo Road
Waltham, MA 02154

Dear Colonel Scheider:

Re: Weymouth Fore River
Navigational Improvements

Thank you for the opportunity of reviewing the project report and environmental assessment concerning the proposed navigational improvements to the Weymouth Fore River in Weymouth and Braintree.

We support the proposed project and will work cooperatively with both the Towns and the Corps to see the work become a reality.

The Waterways Division has similar and related proposed dredging projects at the Neponset River in Dorchester; at the Port Norfolk Yacht Club, the Milton Town Landing and at Allerton Harbor in Hull. We are in the process of attempting to satisfy the interests of E.P.A. and others as it relates to bioassay and bioaccumulation testing and associated environmental compatibility evaluations. The results of those tests can and will be available to you should they be of value, as it may relate to the proposed Fore River project. Please advise.

Thank you for the opportunity of supporting this important and necessary project.

Very truly yours,

John J. Hannon, P.E.
Chief Engineer

NEDPL-C 15 May 1980

Mr. Robert Ingram
Division of Water Pollution Control
110 Tremont Street
Boston, MA 02108

Dear Mr. Ingram:

This office has recently completed a Water Resource Improvement Study for the Weymouth Fore River, Weymouth and Braintree, Massachusetts. The investigation has determined that a viable plan of improvement can be constructed with minimal impacts to the environment.

Based on the anticipated impacts, this office is requesting that a Water Quality Certificate be issued for the proposed work. Inclosed for your review is one copy of the Draft Detailed Project Report, dated April 1980. The document will permit your office to evaluate the proposed plan and determine its acceptability.

Should you require additional information, please contact the Project Manager, Ms. Lydia Wood, at 894-2400, extension 549.

Sincerely,

Incl
As stated

JOSEPH L. IGNAZIO
Chief, Planning Division

cc: Coastal Dev. Br.
Reading File
Planning Div. File

NEDPL-C

16 May 1980

Mr. Edward Reilly
Director, Massachusetts Office
of Coastal Zone Management
100 Cambridge Street
Boston, MA 02202

Dear Mr. Reilly:

This letter is to request a Federal Consistency Determination from your office on the proposed Navigation Improvements to Weymouth-Fore River, Weymouth-Braintree, Massachusetts. Included with this letter is a copy of the Detailed Project Report prepared by our office on this project. Review of this document will show the project, as described, is consistent with Massachusetts Coastal Zone Management Program Regulatory Policies 1, 2, 4, 5, 7, 10, 11, 12, 13, 17 and 19. Specifically:

Policy 1. Protection of wetlands and buffers.

Proposed Project. No dredging will occur in any wetland. The proposed channel configuration will not dredge through any tidal flats or shellfish beds.

Policy 2. Areas for critical environmental concern.

Proposed Project. The Weymouth-Fore River is not an area for Preservation or Restoration or an Area of Critical Environmental Concern as defined by Massachusetts Coastal Zone Management. However, the river is an anadromous fish run. As stated in the Detailed Project Report, the river will be dredged during the fall to avoid any adverse impacts.

Policy 4. Construction in water bodies, erosion control structures.

Proposed Project. This policy is not applicable because no structures are planned in conjunction with the proposed project.

Policy 5. Dredging and dredged material disposal.

Proposed Project. Dredging will not cause flooding nor adversely affect flood storage capacity, flushing rates, ambient salinity, or temperature. Turbidity levels will temporarily increase as a result of construction. No significant adverse effects on marine productivity are expected as a result of dredging. Significantly, productive shellfish beds will not be disrupted. Water quality standards would be exceeded during dredging, but should return to background levels shortly after dredging is completed.

Dredging will be scheduled to avoid conflicts with anadromous fish runs and will not interfere with local recreational boating. Mechanical dredging is planned (as opposed to hydraulic) because open water disposal of dredged sediments is the preferred alternative.

Testing procedures, to date, have included elutriate tests, bulk sediment analysis, and bioassaystests. These sediments are not considered suitable for beach nourishment. The Corps of Engineers will comply with the five conditions specified for ocean disposal. Disposal is scheduled for the Boston Foul Area.

Policy 7. Licensing port and harbor development.

Proposed Project. This policy applies to commercial development and use of port areas, and, as such, is not applicable to the proposed recreational project at Weymouth-Fore River. The location of the proposed dredging is upstream of the designated port area.

Policy 10. Conformance to existing air and water permit requirements.

Proposed Project. The Corps of Engineers has applied for a Massachusetts Water Quality Certificate for the proposed dredging. The proposed project is not expected to violate air pollution standards, nor will it adversely impact any productive wetlands.

Policy 11. Scenic rivers, outdoor advertising.

Proposed Project. This policy is not applicable to the proposed dredging of Weymouth-Fore River.

Policy 12. Impacts on historic districts and sites.

Proposed Project. The project, as proposed, will not adversely impact any historic site. The Massachusetts Historical Commission, in a letter dated 27 July 1978, indicated that significant historical and archeological resources are not likely to exist.

Policy 13. Impacts on public recreation beaches.

Proposed Project. Not applicable. The proposed project is designed to improve navigation for the existing recreational boating fleet on the river.

Policy 17. Funding erosion control measures.

./549

NEDPL-C
Mr. Edward Reilly

16 May 1980

Proposed Project. Not applicable. The project will not require implementation of flood control measures.

Policy 19. Funding port and harbor dredging.

Proposed Project. The proposed project provides for an improved navigation channel for the existing recreational fleet utilizing the Weymouth-Fore River. The area to be dredged is adjacent to a designated port area and already sustains heavy recreational usage.

Should you have any questions, please feel free to contact me at 894-2400, extension 220. Ms. Wood, of my staff, coordinated the investigation. Should your staff desire more information, she can be reached at extension 549.

Sincerely,

Incl
As stated

WILLIAM E. HODGSON, JR.
Colonel, Corps of Engineers
Deputy Division Engineer

cc: Executive Office
Coastal Dev. Branch
Reading File
Planning Div. File

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
P.O. Box 1518
Concord, New Hampshire 03301

MAY 20 1980

Colonel William E. Hodgson
Deputy Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Hodgson:

We have reviewed the draft Detailed Project Report and Environmental Assessment for the proposed navigation project at Weymouth Fore River, Massachusetts. It appears to adequately describe the project but the description of some environmental impacts may need to be changed as a result of spoil sediment tests still to be completed.

We don't agree with the implication that siltation will stop if the channel is dredged as proposed. This appears on page 5, paragraphs 3 and 6, and page 2-2, paragraph 7. We believe that siltation will continue unless other specific action is taken to reduce it. While the deepened channel might help to flush out some of the incoming silt, it is unlikely to have much effect upon continued siltation or silt deposits outside the channel. Statements regarding this impact of channel dredging should be supported with additional justification or revised.

The Recommended Plan on page 15 should describe the frequency of maintenance, the anticipated amount of spoil expected to result from periodic maintenance and the location of the selected site for maintenance spoil.

The study planned by the Town of Braintree hopefully will lead to reducing sediment entering the area to be dredged. This effort should become a part of the recommended plan, or at least emphasized in the report, because it should reduce maintenance dredging costs.

The first paragraph on page 15 states that the bioassay tests show that there would be no adverse impact upon marine life at the disposal site. This statement is not consistent with the last sentence of the second paragraph on page 22 referring to continued testing to determine if any unacceptable impacts will occur. The "finding of no significant impacts" (page 31, Section VII) may have to be revised as a result of the continued testing.

Your description of alternate plans fails to mention spoil disposal. It was considered in another section. We feel that spoil disposal should be considered and described along with alternate plans listed on page 8 and page 2-2 even if they are the same for each alternate. In this way each alternate would be a complete plan. A plan to dispose of spoil in a containment site also should be included with the alternatives. Such a plan should be seriously considered as an Environmental Quality plan because it would result in removal of polluted materials to a relatively safe disposal site.

The second planning objective on page 6 is that the project would contribute to the protection of salt marshes and tidal flats during the 50-year analysis period. It is not made clear if this will be achieved and how the selected plan will protect wetlands. If such protection is anticipated it should be included as a beneficial impact on page 20. Table 1 on page 11 shows that Plan B will have no adverse impact or positive impact on shoreline wetlands (B. Impact Assessment) while having positive effects on protection of saltmarshes (C. Plan Evaluation). The first is symbolized by an "O" and the second by a "4 positive." We suggest that use of + and - to indicate positive and negative numbers would be easier to understand.

Please send us the results of the additional tests for our further evaluation as soon as they are completed.

Sincerely yours,

Gordon E. Beckett

Gordon E. Beckett
Supervisor

OFFICE OF THE DIRECTOR

The Commonwealth of Massachusetts

Water Resources Commission

Division of Water Pollution Control

110 Tremont Street, Boston 02108

June 12, 1980

Joseph L. Ignazio
Chief, Planning Division
Department of the Army
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Re: Water Quality Certification
Improvement Dredging
Fore River
Weymouth, Braintree

Dear Mr. Ignazio:

In response to your request in your petition dated May 15, 1980, this Division has reviewed your application for a permit to conduct improvement dredging of an 8,000 foot long channel by clamshell dredge in the Fore River in Weymouth and Braintree, Massachusetts.

In accordance with the provisions of Section 401 of the Federal Water Pollution Control Act as amended (Public Law 95-217), this Division hereby issues the following Water Quality Certification relative to this project:

1. The dredging portion of the project could result in a violation of water quality standards adopted by this Division. Therefore, reasonable care and diligence shall be taken by the contractor to assure that the proposed activity will be conducted in a manner which will minimize violations of said standards.

2. It has been determined that the material to be dredged is polluted according to dredged material standards adopted by this Division. Disposal of this dredged material in any waters of the Commonwealth is therefore prohibited. It is understood that these materials will be disposed of at "Boston Foul Area".

3. Due to the anadromous fish runs in the Fore River, dredging shall not be conducted from March 1 to June 1.

20 JUN 1980

Should any violation of the water quality standards or the terms of this certification occur as a result of the proposed activity, the Division will direct that the condition be corrected. Non-compliance on the part of the permittee will be cause for this Division to recommend the revocation of the permit(s) issued therefor or to take such other action as is authorized by the General Laws of the Commonwealth. This certification does not relieve the applicant of the duty to comply with any other statutes or regulations.

Very truly yours,

Thomas C. McMahon
Director

TCM/RJI/wp

cc: Anthony D. Cortese, Sc.D., Commissioner, Department of Environmental Quality Engineering, 100 Cambridge Street, Boston, MA 02202
Morgan Rees, Chief, Permits Branch, Corps of Engineers, 424 Trapelo Road, Waltham, MA 02154
John J. Hannon, Director, Division of Land & Water Use, Department of Environmental Quality Engineering, 100 Nashua Street, Boston, MA 02114
Richard Cronin, Director, Division of Fisheries & Wildlife, 100 Cambridge Street, Boston, MA 02202
Philip Coates, Director, Division of Marine Fisheries, 100 Cambridge Street, Boston, MA 02202
Richard Tomczyk, Coastal Zone Management, 100 Cambridge Street, Boston, MA 02202

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

COASTAL ZONE
MANAGEMENT

July 7, 1980

Colonel William E. Hodgson, Jr.
Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02154

Re: NEDPLC - Weymouth Fore River Consistency Review

Dear Colonel Hodgson:

We have completed our review of your May 16, 1980 consistency determination for the Weymouth Fore River Navigation Improvements. We agree with your determination that the proposed project is consistent with MCZM policies (7.13b MCZM regulations).

Sincerely,

Edward J. Reilly
Assistant Secretary

EJR/MEP:dc

APPENDIX 4

ENGINEERING INVESTIGATIONS, DESIGN AND COST ESTIMATES

ENGINEERING INVESTIGATIONS, DESIGN, AND COST ESTIMATES

Table of Contents

TABLES

CHANNEL DIMENSIONS

1. The selection of the width and depth of channel improvement was predicated on the types, quantities, and drafts of vessels utilizing the area. Presently there are 280 vessels utilizing the river. Table 4-1 indicates the average length, width and depth of the power and sail vessels both utilizing the area and expected to use the area during the project life.

Table 4-1

	Present	Future
Sail		
Length	30	36
Width	11	11
Draft	4'7"	5'2"
Power		
Length	31	30
Width	12	12
Draft	3	3

2. The channel would be utilized predominately by recreational vessels drawing 3 to 5 feet of water. A design vessel, based on average user vessel dimensions was therefore chosen as one with a width of 12 ft. and a draft of 5 ft.

3. From these numbers minimum channel dimensions were developed. Based on the draft of the design vessels 6 feet at MLW is a minimum depth. This allows a one-foot underkeel clearance for the design vessel at low tide. Using the commonly used criteria for determining channel depth of five times the beam the minimum design width is 60 feet. The channel was designed with a slope of 1 vertical to 3 horizontal.

4. Because the Metropolitan Y.C. is located near the downstream section of the channel and almost one half of the vessels come from the Metropolitan Y.C. the river sustains increased useage on the downstream section. A 100-foot wide channel at this section was considered important for vessel safety. This width will decrease to 60 feet at the upstream end.

DREDGED MATERIAL EVALUATION

5. Grab samples were taken at the locations shown in Figure 4-1, to obtain an indication of sediments found in the Weymouth-Fore River.

6. Samples indicate the material to be recently deposited sand and silt, with a small amount of organic matter present. This material is easily removed with a clamshell bucket dredge. Previous surveys show deeper water in the area, indicating recent deposition.

DREDGING REQUIREMENTS

7. Dredging of a channel at Fore River will be performed by a clamshell bucket dredge. The channel would be dredged starting from the main ship channel towards the Quincy Avenue Bridge (Route 53).

8. It is proposed that disposal of the dredged material be at sea. (Appendix 6 contains a detailed analysis of the dredged material disposal options.)

9. Due to local concerns the dredging operation will be limited to a 16-hour (7 A.M. to 11 P.M.) 5-day week work schedule. Approximately one month will be required to complete the project.

10. Dredging quantities required for each plan presented were computed utilizing the "average end area method." Existing conditions utilized for these computations were taken from a hydrographic survey performed in 1979. Estimates of quantities to be dredged are based on a project depth of 6 feet MLW plus a 1-foot overdepth.

COST ESTIMATES

11. Table 4-2 gives a detailed cost estimate for dredging Plan A (the selected plan). This cost estimate is based on using a clamshell bucket dredge, working a 16-hour day 5 days a week, with disposal at the Boston "Foul Area."

TABLE 4-2

Plan A

Mobilization and Demobilization	$ 28,000
Dredging 31,000 c.y. @ $8.70	269,700
Contingencies 15%	44,300
Contractor Cost	$342,000
Engineering and Design 9%	32,000
Supervision & Administration 8%	26,000
Total Estimated Construction Cost	$400,000
Aids to Navigation	1,500
Total Project Cost	$401,500

12. The annual charges of the project are calculations on the total first cost amortized at 7-3/8 percent over a 50-year period. The maintenance charges are based on a shoaling rate of 4 percent. The maintenance cost is then 4 percent of the first cost of construction. The summary of annual charges is given in Table 4-3.

TABLE 4-3

Annual Charges

Annual Charges (based on 7-3/8% discount rate)		$ 30,300
Maintenance Charges		$ 16,000
Total Annual Charges		$ 46,300
Benefit/Cost Ratio		7.8:1
Net Annual Benefits (annual benefits less annual charges)	say:	$314,700

13. Table 4-4 gives a detailed cost estimate for dredging Plan B. This cost estimate is based on using a clamshell bucket dredge, working a 16-hour day 5 days a week, with disposal at the Boston "Foul Area."

TABLE 4-4

Plan B

Mobilization and Demobilization	56,000
Dredging 39,000 c.y. @ $8.70	339,300
Contingencies 15%	59,200
Contractor Cost	454,500
Engineering and Design 9%	40,900
Supervision & Administration 8%	36,300
Total Estimated Construction Cost	531,700
Aids to Navigation	2,300
Total Project Cost	$534,000

14. The annual charges of the project are calculations on the total first cost amortized at 7-3/8 percent over a 50-year period. The maintenance charges are based on a shoaling rate of 4 percent. The maintenance cost is then 4 percent of the first cost of construction. The summary of annual charges is given in Table 4-5.

TABLE 4-5

Annual Charges

Annual Charges	
(based on 7-3/8% discount rate)	$ 40,500
Maintenance Charges	$ 21,000
Total Annual Charges	$ 61,500
Benefit/Cost Ratio	5.8:1
Net Annual Benefits ($362,100 - $61,500)	
(annual benefits less annual charges) say:	$300,600

15. Table 4-6 gives a detailed cost estimate for dredging Plan C. This cost estimate is based on using a clamshell bucket dredge, working a 16-hour day 5 days a week, with disposal at the Boston "Foul Area."

TABLE 4-6

Plan C

Mobilization and Demobilization	$ 28,000
Dredging 171,000 c.y. @ $8.70	1,710,855
Contingencies 15%	260,000
Contractor Cost	$1,998,855
Engineering and Design 9%	180,000
Supervision & Administration 8%	160,000
Total Estimated Construction Cost	$2,022,500
Aids to Navigation	2,600
Total Project Cost	$2,024,500

16. The annual charges of the project are calculations on the total first cost amortized at 7-3/8 percent over a 50-year period. The maintenance charges are based on a shoaling rate of 4 percent. The maintenance cost is then 4 percent of the first cost of construction. The summary of annual charges is given in Table 4-7.

TABLE 4-7

Annual Charges

Annual Charges (based on 7-3/8% discount rate)		$153,600
Maintenance Charges		$ 80,900
Total Annual Charges		$234,500
Benefit/Cost Ratio		2.2:1
Net Annual Benefits ($582,500 - $234,500) (annual benefits less annual charges)	say:	$297,900

MAINTENANCE

17. Based on a comparison of hydrographic surveys of the area approximately 28,000 cubic yards of sediment have been deposited in the area from 1954 to 1979. This means that an average sedimentation rate is approximately 1,120 cubic yards. This shoaling rate of 4 percent is used to compute probable maintenance cost associated with the project.

18. However, it is reasonable to assume the average sediment rate has been influenced through extensive upstream development which has occurred since the 1950's. This would then infer that the shoaling rate would be expected to decrease as the upstream development decreases. This would mean that future shoaling should be lower over the life of the project.

APPENDIX 5

SOCIAL, CULTURAL, AND ECONOMIC EVALUATION

APPENDIX 5
SOCIAL, CULTURAL AND ECONOMIC RESOURCES

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SECTION A

EXISTING CONDITIONS

The base condition is a composite of existing cultural, social, and economic, characteristics of the study area.

Cultural Resources

The Massachusetts Historical Commission has determined that there are no signficicant cultural resources in the study area.

Appendix 3 contains correspondence pertaining to this determination.

Social and Economic Characteristics

Braintree and Weymouth, which were both first settled in the 1600's, are suburban communities of Boston and Quincy. Their economies developed along similar lines with argiculture, fishing, and light industry becoming the mainstays of the communities. Leather shoes, nails, carpets, and paper were among the products manufactured in the towns during the 1800's. The 1900's saw the decline of manufacturing and the rise of service industries which today comprise a significant sector of the towns' economies.

Estimated 1980 populations for Braintree and Weymouth are 36,243 and 55,366, respectively. Generally the two towns have grown faster than Boston Standard Metropolitan Statistical Area (SMSA) of which they are members. Table 1 presents the growth in population of the two communities as compared to the Boston SMSA.

TABLE 1
POPULATION TRENDS
BRAINTREE, WEYMOUTH, BOSTON SMSA

	Braintree		Weymouth		Boston SMSA	
	#	% chg from preceding decade	#	% chg. from preceding decade	#	%chg. from preceding decade
1980	36,243	3.4	55,366	1.4	*	
1970	35,050	12.8	54,610	13.4	2,753,700	6.1
1960	31,069	34.1	48,177	47.4	2,595,481	7.5
1950	23,161	41.4	32,690	37.0	2,414,368	*
1940	16,378	4.2	23,868	14.3	*	*
1930	15,712	-	20,882	-	-	-

*not available

It can be seen that population growth for Braintree and Weymouth has leveled off over the past decade. Projections for the future show a continuation of the most recent trend, i.e., population increasing at a decreasing rate. Reasons behind the expected decreasing rate include declining birth rates and the slowdown of economic growth in Massachusetts.

The relative economic condition of the two towns appears to be slightly better than that of the Boston SMSA as a whole. The 1970 medium family incomes for the areas were: Braintree - $13,030, Weymouth - $11,689, SMSA - $11,449. The percentage of families with incomes less than 7,000 is smaller for the two towns that it is for the SMSA. The respective percentages are as follows: Braintree - 12.9, Weymouth - 16.2 Boston SMSA - 21.5. At the same time, the percentages of families with incomes of $25,000 and over is greater in the SMSA than in Braintree and Weymouth.

The people of Braintree and Weymouth are housed predominately in single family homes. As residential suburbs, these towns provide housing for a number of people who work in Boston and Quincy. Large businesses that located in the town in the past provided tax revenues and helped to hold down tax rates. Boston Edison provided 40 percent of Weymouth's tax revenues in the 1950's and General Dynamics provides similar benefits for Braintree. The low tax rates contributed to the area's desirability as a place of residence.

Although 60 percent of all housing units in Weymouth are single family and 83 percent are single family in Braintree, multi-family housing is expected to grow proportionally faster. Although there seems to be an abundance of apartments, housing for low income and elderly persons is in short supply.

Those employed in Braintree and Weymouth work primarily as professionals, clerical workers, and craftsmen. This is shown in Table 2.

TABLE 2
Occupations of Labor Forces: Braintree, Weymouth

	Braintree	Weymouth
Prof., Tech., Kindred	2259	3473
Managers, Admin.	1429	1873
Sales Workers	1393	1952
Clerical, Kindred	3120	4880
Craftsmen, Foreman	2173	3863
Operatives, Except Trans.	1168	2054
Transport, Equip. Operatives	362	648
Laborers, Except Farm	367	710
Farmers, Farm Managers	18	23
Farm Laborers, Foremen	22	23
Service Workers	1655	2609
Private Household Workers	42	88
	14308	22196

Source: 1970 U.S. Census

The greatest proportions of workers are employed in the wholesale/retail trades, manufacturing, and service sectors. This is illustrated in Table 3.

TABLE 3
Industry of Employed Persons

	Braintree			Weymouth		
	1977	% of Total	% chg. over 1967	1977	% of Total	% chg. over 1967
Agric., Forestry, Fisheries	46	0.2	142.1	133	1.5	60.2
Mining & Construction	771	4.1	-10.2	532	6.2	8.9
Manufacturing	3,669	19.5	-7.2	1,255	14.5	46.1
Trans., Comm., Util.	841	4.5	183.2	673	7.8	24.9
Wholesale & Retail Trade	9,084	48.4	99.3	3,028	35.1	35.7
Finance, Insurance & Real Estate	1,101	5.9	364.6	326	3.8	84.2
Services	3,271	17.4	197.9	2,686	31.1	158.8
Total	18,783	100.0	70.7	8,633	100.0	59.6

The overall employment situation for the towns is presented in Table 4. (July 1979)

TABLE 4
Employment and Unemployment: Braintree, Weymouth
(July 1979)

	Braintree	Weymouth
Labor Force	16760	26879
Employment	16061	24899
Unemployment	699	980
Unemployment Rate	4.1	3.8

Source: Massachusetts Division of Employment Security

Land Use

Land use in the two communities include residential, commerical, industrial, public, utility, open space, and vacant categories. Of particular interest are use of land near the proposed project site. The study are is comprised of a north and south shore. The north shore is in Braintree and consists mainly of residential land. The land directly abutting the water is the home of both the Metropolitan and Braintree Yacht Clubs. Between the yacht clubs lies a playground, Watson's Park, and Smith's Beach. Further downstream the Braintree Electric Light Department occupies the shoreline. Other parcels are owned by Boston Edison and City Service.

Further inland the vast majority of properities are residential. Upstream from the Braintree Yacht Club is the Quincy Street Bridge. On one side of the bridge is a power plant. Commercial establishments dominate this area.

The south shore is in Weymouth. The upstream section of the shore is largely commerical. Boston Gas and a deserted lumber yard are situated here. Beyond this area lies a salt water marsh and filled land owned by Boston Edison. The shore is then occupied by transmission towers, followed by a residential neighborhood, a small beach, the Mill Cove tidal flat, and the Boston Edison generating plant. Further inland is a residential area, Route 53, and commerical estblshments. Beyond Quincy Street bridge are several apartment buildings within 100 feet of the river. The main retail center in the communities, Weymouth Landing, is situated partially in Weymouth and partially in Braintree, is about one mile from the study area. (Plate 7 shows the generalized land use of the area.)

Recreation on the Weymouth Fore River

Recreational usage along the Weymouth Fore River is either boating, swimming or shellfishing. Presently shellfishing is minimal due to pollution problems. Seasonally swimming from Idelwell Beach and Smith Beach influences the large person hours spent on recreation. Smith Beach has a life guard on duty during the summer.

Recreational boating on the river is extensive. There are two yacht clubs and a public launching ramp located on the Braintree side of the river. There are two boatyards located on the Weymouth side of the river. Presently, there are approximately 300 boats utilizing the river. These boats are 80 percent power boats and 20 percent sailboats. This is approximately a 10 percent increase in sail boats over the last 10 years. The average boat on the river is 30 feet long with a draft of 5 feet.

Economics of the Recreational Boating in the Region

Recreational boating in the greater Boston area is growing rapidly. There are several factors which point to economic growth of the industry as a whole in this region. Recent studies have indicated some possible future trends in the recreational boating industry. Beginning in 1972 due to the energy crisis, sailboat sales started to increase. From 1975 to present, sailboat sales have increased 72 percent or approximately 14.4 percent per year. Power boats especially inboards have dropped dramatically.

Other studies have indicated that the trends in fleet composition are moving towards 50 percent sail and 50 percent power. However, these studies do not reflect the possibility of increased fuel efficiency in power boats. They do not consider the fact that the market has for so long been glutted with power boats that the overall fleet composition will take at least 15 to 20 years to change as existing power boats are eventually retired.

Presently, the supply of marine facilities, moorings, berths, and anchorages is 62 percent behind the demand. With demand increasing at 14 percent and supply increasing at 21 percent in the foreseeable future there will be an even greater excess of demand over supply than that which now exists.

Present marine support facilities are expensive to build and maintain considering the current average mooring fees at marina facilities in this area. In order for a facility to be profitable it must be able to hold approximately 200 boats or more. Furthermore, the most profitable facilities are those that service power vessels due to the attendant services required for each vessel. This implies that with the decline in power vessels there will be a further decline in new marinas due to the lower profit margin. Because of this, anchorage areas and mooring will be at a premium and any existing facilities must be fully utilized.

SECTION B

FUTURE CONDITIONS WITHOUT THE FEDERAL PROJECT

The existing conditions in the study area provide a back ground to develop future conditions without the project.

Without the project, shoaling conditions in the river will continue. this shoaling will cause decreased tidal flushing, decrease aesthesic on the river, and decrease recreation in the area. Impacts of this shoaling are both site specific and regional in nature.

In general, Braintree and Weymouth are reaching growth maturity. In Braintree, for example, less than 20% of all privately-owned land remains undeveloped. Past commerical and industrial growth in Braintree has placed a strain on public facilities. New work on drainage, bridge widening, and other improvements may be necessary in various locations in the town. Development in both towns has reached a point where drastic changes in land use are not to be expected because of lack of development area and zoning restrictions. The increased restriction on boating and negative impacts of additional shoaling would make the communities less desirable for recreational purposes.

The continued shoaling then will not impact on future development of the area. However, it is reasonable to expect that the communities will be less desirable to live in and therefore become more transient in nature.

As for site specific problems, continued shoaling will significantly restrict boating usage along the river. The danger caused by vessel traffic congestion would worsen and due possibility of groundings would increase. If this continues, it could cause abandonment of the yacht clubs and public facilities. This would cause an adverse econmic impact on the area. This would also further burden the regional facilities by causing increased demand.

SECTION C

ALTERNATIVES AND THEIR IMPACTS

Plan A entails dredging the 8,000-foot long channel to a depth of 6 feet mean low water (MLW). The plan would:

a. Widen the channel to a width of 100 feet where the present 35-foot channel ends, extending upstream 2,500 feet to the eastern end of the Idlewell.

b. Widen the channel to 75 feet where the 100-fooot width ends, extending upstream for about 3,000 feet to the site of Watson Park.

c. Widen the channel to 60 feet where the 75-foot width ends extending upstream for 2,500 feet to the site of the Braintree Power Station.

Plan B is similar to Plan A except that dredging would continue 600 feet upstream of the Quincy Avenue Bridge.

Plan C contains the channel design elements of Plan B plus two anchorage areas for a combined total of 8 acres.

Cultural Impacts

There will be no significant cultural impacts involved with any of the evaluated plans.

Social Impacts

The plans would have similar impacts. Short term effects that would occur during project construction are noise, odors, and emission from dredging operations. Dredging in the fall season would serve to lessen these effects and would minimize interruption of the use of the river by boaters and swimmers. The limited presence of construction equipment and vehicles would add little to neighborhood traffic congestion. Again, because dredging is to occur during the off season, any delay to pedestrian and vehicular traffic that does occur would be minimal.

Plan D which would increase the size of the recreational fleet would have a few minor impacts on the area. Plan D could possibly increase parking and traffic problems in the area.

Another impact of the plans is that by increasing the recreational desirability of the river, the project would likely raise the property value of nearby homes. Also, small businesses in the area such as gas stations, restaurants, and stores might obtain increases sales from day visitors drawn to the area.

Economic Impacts

The economic impacts of the plans are both quantifiable and non-quantifiable. This section describes those impacts which are not quantifiable. Quantifiable impacts are discussed under benefit analysis.

The project would provide a minimal amount of temporary employment. Workers would be supplied by the contractor hired to do the work. Small businesses in the area would obtain a small amount of increase sales due to the presence of the laborers. A small increase in the demand for local utilities such as water and electricity would occur due to the presence of construction equipment and crews. Construction should not result in displacement of residents or signficant change in the physical characteristics of existing residential and commerical buildings.

SECTION D

BENEFIT ANALYSIS

Benefit analysis of the Weymouth Fore River fleet is predicted on the size and composition of the boats using the river. This section details the quantifiable benefits that would be gained from the various alternatives.

In general, recreational boats are either power boats or sailboats. These two classifications are then separated even further. Power boats are either outboards, sterndrives, or inboards. Sailboats can be classified as cruising or daysailers.

Cruising sailboats are heavier then daysailers and draw more water. Daysailers are generally trailerable. Daysailers, even though they can be trailered are not launched everytime they are used. Daysailers very often do not have auxiliary engines where as cruising vessels do.

Presently, the existing fleet has 280 boats not including transients. Of these boats 208 are inboard motor boats, 27 are outboard motor boats and 45 are sailboats, in percentages roughly 20% sail versus 80% power. The average length of an inboard is 31 feet, however, 52% of the fleet is over 31 feet long. The average length of the outboards is 18 feet long. The average length of the sailboats is 30 feet long with 55% of the sailboat fleet greater than 30 feet in length.

Fifteen years ago the fleet was 92% power, 8% sail with the average length for inboards 25 feet long and sail boats 20 feet long.

The number of vessels increased from approximately 180 in the 1960's to its present 280 in 1975. The fleet has not grown since then. Furthermore, transient usage of the area has dropped to zero.

Methodology

The Flood Control Act of 1936 has molded the developmentof benefit-cost analysis through its requirement that Corps of Engineers civil works projects be economically justified: the estimated costs of such projects should be exceeded by their benefits.

Navigation benefits are derived from: (1) projected savings in the cost of transporting commodities on the improved waterway, (2) removal of hazards to shipping, (3) gains to commerical fishing, (4) increased recreational boating and sports fishing, (5) land enhancement, and (6) reduced damages to shorefront facilities.

As the subject study has been required in the interest of recreational boating, the following paragraphs will explain the methodology utilized in assessing and accruing economic benefits for improvements to recreational boating harbors and waterways.

The methodology for the evaluation of recreational navigation benefits was adopted under the direction of the Office of the Chief of Engineers on 3 February 1950. The method assumes the recreational benefits cannot be evaluated with mathematical precision, but that reasonable and presentative percentages reflecting the net return on the depreciated investment in a fore-hire fleet of small boats are reasonable gages. Therefore, recreational benefits are based on the net return above costs that the owners of private recreational craft using or expected to use the harbor would receive if they rented their boats on a fore-hire basis.

The recreational benefit that may be realized, because of improved navigation conditions, falls normally into two main categories:

(1) Increased utilization of the waterway by the existing permanent and transient fleet.

(2) The attraction of new vessels to the area.

The procedure for computing the actual dollar value benefit can be divided into eight basic steps:

Step 1 - Identify all craft using the harbor on a full and part-time (transient) basis by number and class; for example, cruiser, inboards, sailboats, etc. Transient craft can usually be converted in an equivalent number of permanently-based craft in terms of boat-days. For example, if there are 200 days in the season, the harbor has 200 boat-day use. Should 100 transient craft spend 2 days in port here would result 200 boat-days or the equivalent of 1 harbor-based craft.

Step 2 - Determine for each class the average depreciated value over the vessel's service life. Assuming straight-line depreciation, this would be one-half the average value new.

Step 3 - Assign an ideal percenage of net annual return for hire above cost that could be assumed to accure to each class of boat. Surveys of boating practices have found this figure to vary between 6 and 15 percent. The variation in the ideal number permits leeway to fit local conditions: length of season, availability of alternative forms of recreation, access to other small boat harbors, income range of the using public, etc.

Step 4 - Determine the extent to which existing conditions restrict full realization of the ideal net reutn. For example, if the

present navigation system is adequate for all outboards then the proposed improvements may not result in any benefits, since the onwers are realizing the system's full ideal net return. However, if large boats are forced to wait for tides prior to movement, it may be estimated that they are receiving only say 75 percent of the ideal benefit. Then after improvements are provided, they may receive say 95 percent of the ideal benefits due to the reduction of tidal dealys. The difference between the existing return and the future return (in this case 20 percent) is considered the measured value of the improvement. The benefit attributed to these vessles would, therefore, be 20 percent of their average depreciated value. This exercise is repeated for all classes of vessels and the benefits for each class are assumed to obtain the total benefit associated with the existing fleet.

Step 5 - Ascertain the number of new boats, permanent and transient, that may reasonably be expected to use the waterway if proved, and estimate their depreciated value by classes over their sevice life. Convert transient vessels to an equivalent number of permanent vessels as discussed in Step 1.

Step 6 - Apply the value of the selected depreciated values and percentages of retun as chosen in Steps 2 and 3 to all new vessels and determine the percent of ideal utilization that these vessels will obtain with the project in an improved condition. Compute the benefit to new vessels based on return of depreciated value at that percentage of ideal utilization. The sum of these benefits represents the net annual benefits to the new fleet.

Step 7 - Determine the percentage of time, by class, harbor-based craft are away from port (on cruise) and reduce the anticipated benefit accordingly. For example, in the event that long-range cruising resulted in absence from the home port, without returning, for one-half the season, the anticipated recreational benefit would be reduced by 50 percent.

Step 8 - The sum of the net benefits found in Steps 4 and 6 minus Step 7 is considered to represents the annual recreational value of the improved harbor to small-boat navigation.

Benefits to Existing Fleet

Plan A. The benefits associated with Plan A on the Weymouth Fore River are shown on Table 5-5. This shows that if Plan A were implemented,

existing vessels using the river would gain 30% more usage of the river for an annual gain of $362,100. An additional gain of $23,000 would accrue from reducing the damages presently sustained by the fleet. These damages are causes by groundings, and engine cooling system intakes sucking in mud which causes engine damage. This would provide a total benefit of $362,100.

Plan B. The benefits associated for Plan B are $362,100, the same as Plan A. This indicates that even though the channel would be longer than Plan A, the boats using the river would gain nothing from the 600 foot extension. This occurs because of the fixed clearance of the Quincy Avenue bridge.

Plan C. The benefits associated with Plan C are $362,100 for reduced tidal delays to the existing fleet plus $170,400. Associated with the new 57 new vessels that would utilize the area would make the total annual benefits attributated to Plan C $532,500.

As can be seen in Table 5-6, the new vessels would gain 100% usage while existing vessels only 32% gain in usage.

Benefits to Future Fleet

In order to assess the potential future need and justification for the project benefit evaluations for changes in fleet composition were analyzed. Given the present trends in recreational fleet composition two possible changes could occur. The fleet could develop to 50% power vessels and 50% sail vessels or the fleet could change to 100% sail boats. These two possibilities are shown as Scenario 1 and 2.

Scenario 1.

This scenario would change the fleet composition to 50% power boats and 50% sailboats. With this change the annual benefits attributable to the navigation channel improvements is $230,965. These would then be the annual benefits attributable to Plans A and B if Scenario 1 were to occur. For Plan C, if Scenario 1 were to occur, the benefits attributable to the anchorage are $55,900. Thus, the total annual benefits attributable to Plan C, Scenario 1 are approximately $287,000. Tables 5-1 and 5-8 show these benefits.

Scenario 2.

Scenario 2 would change the fleet composition to 100% sail. If this were to occur the benefit for Plans A and B would be $138,500 annually, while the benefits for Plan C are $172,600. Tables 5-9 and 5-10 show these benefits.

SECTION E

B/C Ratios and Net Benefits

After the benefits were calculated for the existing fleet and the two scenarios, the benefit cost ratio and net beneifts were calculated. Table 5-11 shows the B/C ratio and net benefits for all plans. Plan C was further

analyzed incrementally for benefits attributable solely to the anchorage and solely to the channel. Based on these numbers, the anchorage in Plan C is not justified for either potential fleet changes. This shows tha only the channel in Plan C is justified. This channel is Plan A.

Based on the two scenarios, Plan A is justified and would provide the maximum net benefits.

TABLE 5-11

	Existing	S1	S2
PLAN A			
B/C	7.8:1	5.0:1	3.0:1
Net	316,000	184,900	92,500
Annual	362,100	230,900	138,500
PLAN B			
B/C	5.8:1	3.7:1	2.2:1
Net	300,600	169,500	77,000
Annual	362,100	230,900	138,500
PLAN C			
B/C	2.2:1	1.2:1	0.7:1
Net	297,900	52,400	0
Annual	532,500	286,800	172,600
PLAN C (Channel)			
B/C	7.8:1	5.0:1	3.0:1
Net	316,000	184,900	92,500
Annual	362,100	230,900	138,500
PLAN C (Anchorage)			
B/C	0.9:1	0.2:1	0.1:1
Net	0	0	0
Annual	170,400	55,900	34,100

SECTION F

Conclusions

Based on both the quantifiable benefit analysis and the non-quantifiable analysis, Plan A is the most responsible plan to the present and potential future needs of the area.

EXISTING FLEET
1980 BOATING VALUES

TABLE 5-5 - BENEFITS TO RECREATIONAL BOATING

HARBOR:

TYPE OF CRAFT	LENGTH (Feet)	# of Boats	DEPRECIATED VALUE Average $	DEPRECIATED VALUE Total $	Ideal	PERCENT RETURN % of Ideal Pres.	PERCENT RETURN % of Ideal Fut.	Gain	Value $	ON CRUISE Avg. Days	ON CRUISE % of Season	ON CRUISE Value $
RECREATIONAL	FLEET											
Outboards	15-20	28	4,350	121,800	14	60	100	5.6	6,820			
	21 & Up	5	8,850	44,250	13	60	100	5.2	2,301			
Stern Drive	15-20	15	6,700	100,500	13	60	100	5.2	5,226			
	21-25	5	10,850	54,250	12	60	100	4.8	2,604			
	26 & Up	-	24,200									
Inboards	15-20	-	7,250									
	21-30	89	17,750	1,579,750	12	55	95	4.8	75,828		9	6,824
	32-40	76	47,650	3,621,400	11	55	95	4.4	159,341		12	19,120
	41-50	24	98,050	2,353,200	10	55	95	4.0	94,128		20	18,825
	51-Up	3	255,800	767,400	9	55	95	3.6	27,626		30	8,287
Cruising	15-20	-	6,100									
Sailboats	21-30	14	18,450	258,300	8	55	95	3.2	8,265		5	413
	31-40	9	47,040	423,450	7	55	95	2.8	11,856		16	1,896
	41 & Up	-	93,250									
Daysailers	8-15	-	2,150									
	16-20	3	3,800	11,400	12,	60	100	4.8	547			
	21-25	-	6,300									
	26 & Up	-	11,500									
TOTALS									394,542			55,365

Annual Benefits
394,542 - 55,365 = 339,177
Relocation Damages 23,000
362,177
Say $362,100

NEW FLEET FOR ANCHORAGES
EXISTING COMPOSITION
1980 BOATING VALUES

TABLE 5-6 - BENEFITS TO RECREATIONAL BOATING

HARBOR:

TYPE OF CRAFT	LENGTH (Feet)	# of Boats	DEPRECIATED VALUE Average $	DEPRECIATED VALUE Total $	Ideal	PERCENT RETURN % of Ideal Pres.	PERCENT RETURN % of Ideal Fut.	Gain	Value $	ON CRUISE Avg. Days	ON CRUISE % of Season	Value $
RECREATIONAL	FLEET											
Outboards	15-20	6	4,350	26,100	14	0	100	14	609			
	21 & Up	1	8,850	8,850	13	0	100	13	1,150			
Stern Drive	15-20	3	6,700	20,100	13	0	100	13	2,613			
	21-25	1	10,850	10,850	12	0	100	12	1,302			
	26 & Up	-	24,200									
Inboards	15-20	-	7,250									
	21-30	18	17,750	319,500	12	0	95	11.4	36,423		9	3,278
	32-40	16	47,650	762,400	11	0	95	10.4	79,289		12	9,514
	41-50	5	98,050	490,250	10	0	95	9.4	46,083		20	9,216
	51-Up	1	255,800	255,800	9	0	95	8.5	21,870		30	6,561
Cruising	15-20	-	6,100									
Sailboats	21-30	3	18,450	55,350	8	0	95	7.6	4,206		5	210
	31-40	2	47,040	94,100	7	0	95	6.6	6,210		16	993
	41 & Up	-	93,250									
Daysailers	8-15	-	2,150									
	16-20	1	3,800	3,800	12	0	100	12	456			
	21-25	-	6,300									
	26 & Up	-	11,500									
TOTALS		57							200,211			29,772

Annual Benefits - $170,439

CHANGE IN FLEET COMPOSITION
TO 50% SAIL 50% POWER
1980 BOATING VALUES

TABLE 5-7 - BENEFITS TO RECREATIONAL BOATING

HARBOR:

TYPE OF CRAFT	LENGTH (Feet)	# of Boats	DEPRECIATED VALUE Average $	DEPRECIATED VALUE Total $	Ideal	PERCENT RETURN % of Ideal Pres.	PERCENT RETURN % of Ideal Fut.	Gain	Value $	ON CRUISE Avg. Days	ON CRUISE % of Season	ON CRUISE Value $
RECREATIONAL	FLEET											
Outboards	15-20	28	4,350	121,800	14	60	100	5.6	6,820			
	21 & Up	5	8,850	44,250	13	60	100	5.2	2,301			
Stern Drive	15-20	15	6,700	100,500	13	60	100	5.2	5,226			
	21-25	10	10,850	108,500	12	60	100	4.8	2,604			
	26 & Up	-	24,200									
Inboards	15-20	-	7,250									
	21-30	43	17,750	763,250				4.8	36,636		5	1,831
	32-40	23	47,650	1,095,950				4.4	48,221		6	2,893
	41-50	10	98,050	980,500				4.0	39,220		10	3,922
	51-Up	2	255,800	511,600				3.6	18,417		20	3,683
Cruising Sailboats	15-20	-	6,100									
	21-30	70	18,450	1,291,500				3.2	41,328		5	2,066
	31-40	30	47,040	1,411,500				2.8	39,552		16	6,323
	41 & Up	-	93,250									
Daysailers	8-15	-	2,150									
	16-20	15	3,800	57,000				4.8	2,736			
	21-25	20	6,300	126,000				4.8	6,048			
	26 & Up	-	11,500									
TOTALS									251,683			20,718

Annual Benefits - $230.965

50% SAIL, 50% POWER ANCHORAGE
1980 BOATING VALUES

TABLE 5-8 - BENEFITS TO RECREATIONAL BOATING

HARBOR:

TYPE OF CRAFT	LENGTH (Feet)	# of Boats	DEPRECIATED VALUE Average $	DEPRECIATED VALUE Total $	Ideal	PERCENT RETURN % of Ideal Pres.	PERCENT RETURN % of Ideal Fut.	Gain	Value $	Avg. Days	ON CRUISE % of Season	Value $
RECREATIONAL	FLEET											
Outboards	15-20		4,350									
	21 & Up		8,850									
Stern Drive	15-20		6,700									
	21-25		10,850									
	26 & Up		24,200									
Inboards	15-20		7,250									
	21-30	20	17,750	355,000				4.8	71,040		5	852
	32-40	7	47,650	333,550				4.4	14,676		6	880
	41-50	3	98,050	294,150				4.0	11,766		10	1,176
	51-Up		255,800									
Cruising Sailboats	15-20		6,100									
	21-30	15	18,450	276,750	8	55	100	3.2	8,856		5	442
	31-40	5	47,040	235,250	7	55	100	2.8	6,587		16	1,063
	41 & Up	-	93,250									
Daysailers	8-15	-	2,150									
	16-20	5	3,800	19,000	12	60	100	4.8	912			
	21-25	2	6,300	12,600	10	60	100	4.0	504			
	26 & Up	-	11,500									
TOTALS									60,341			4,403

Annual Benefits - 55,938

CHANGE IN FLEET TO 100% SAIL
1980 BOATING VALUES

TABLE 5-9 - BENEFITS TO RECREATIONAL BOATING

HARBOR:

TYPE OF CRAFT	LENGTH (Feet)	# of Boats	DEPRECIATED VALUE Average $	DEPRECIATED VALUE Total $	Ideal	PERCENT RETURN % of Ideal Pres.	PERCENT RETURN % of Ideal Fut.	Gain	Value $	ON CRUISE Avg. Days	ON CRUISE % of Season	ON CRUISE Value $
RECREATIONAL	FLEET											
Outboards	15-20		4,350									
	21 & Up		8,850									
Stern Drive	15-20		6,700									
	21-25		10,850									
	26 & Up		24,200									
Inboards	15-20		7,250									
	21-30		17,750									
	32-40		47,650									
	41-50		98,050									
	51-Up		255,800									
Cruising	15-20	40	6,100	244,000	8	55	100	3.6	8,784			
Sailboats	21-30	120	18,450	2,214,000	8			3.2	70,848		5	3,542
	31-40	45	47,040	2,117,250	7			2.8	59,283		16	9,485
	41 & Up	10	93,250									
Daysailers	8-15	-	2,150									
	16-20	21	3,800	79,800	12	60	100	4.8	3,830			
	21-25	35	6,300	220,500	10	60	100	4.0	8,820			
	26 & Up	-	11,500									
TOTALS									151,565			13,027

Annual Benefits - 138,538

100% SAIL ANCHORAGE
1980 BOATING VALUES

TABLE 5-10 - BENEFITS TO RECREATIONAL BOATING

HARBOR:

TYPE OF CRAFT	LENGTH (Feet)	# of Boats	DEPRECIATED VALUE Average $	DEPRECIATED VALUE Total $	Ideal	PERCENT RETURN % of Ideal Pres.	PERCENT RETURN % of Ideal Fut.	Gain	Value $	Avg. Days	ON CRUISE % of Season	Value $
RECREATIONAL	FLEET											
Outboards	15-20		4,350									
	21 & Up		8,850									
Stern Drive	15-20		6,700									
	21-25		10,850									
	26 & Up		24,200									
Inboards	15-20		7,250									
	21-30		17,750									
	32-40		47,650									
	41-50		98,050									
	51-Up		255,800									
Cruising Sailboats	15-20	2	6,100	122,000	8	55	95	3.2	3,904			
	21-30	20	18,450	369,000	8	55	95	3.2	11,808		5	590
	31-40	10	47,040	470,500	7	55	95	2.8	13,174		16	1,712
	41 & Up		93,250									
Daysailers	8-15	-	2,150									
	16-20	10	3,800	63,000	12	60	100	4.8	3,024			
	21-25	15	6,300	94,500	12	60	100	4.8	4,536			
	26 & Up	-	11,500									
TOTALS									36,446			2,302

Annual Benefits - 34,144

APPENDIX 6

DISPOSAL OF DREDGED MATERIAL

1

DISPOSAL OF DREDGED MATERIAL

1. As has been discussed in the Environmental Assessment four different disposal options were considered. These were:

A - Wetlands or upland areas adjacent to the river.

B - Inland sites.

C - Marsh Creation.

D - Ocean disposal.

2. The different effects of these four options is discussed in detail in this appendix. Evaluation of these options determined that only ocean disposal is a practical environmentally acceptable option. The approved ocean disposal site that is proposed for this material is the "Boston Foul Area".

WETLANDS OR UPLAND AREAS ADJACENT TO THE RIVER

3. The land area adjacent to the Weymouth Fore River is either saltmarsh, tidal flats, or developed for residential or commercial uses. Much of the existing development is located on filled marsh lands. Because marshes and tidal flats even in an urban estuary environment serve an important ecological function the material being dredged from the river can not be placed upon them. Furthermore, because the remaining land is densly populated there is no upland site available for disposal of this material.

INLAND DISPOSAL

4. Inland disposal has several engineering and environmental constraints associated with it. In order to dispose of the material at an inland site (possibly a sanitary landfill or proposed development area) the material must first be dredged and placed in a temporary containment area to dewater. The the dewatered material must be removed to the inland site.

After this has taken place the temporary containment area must be removed and the area restored to it's original state.

5. Due to the polluted nature of the materials to be dredged from the river the above process would be complicated in several ways. First, because the material would have to be hydraulically disposed of at the temporary containment area the site would need to be large enough to not only receive the 33,000 cubic yards of material but also approximatly 132,000 cubic yards of water. This would increase the area needed to confine the material by a factor of four

6. The elutriate test results (Table 2 of the environmental Assessment) for the sediment to be removed from the river indicate that if a 4 to 1 water sediment ratio is used then substantial pollutants could be released into the water. Therefore, the excess water from dredging the material would be too polluted to simply drain the water back into the river. The only possible manner then that the excess water could be drained would be to discharge it into a sewage system where it could be treated before it was returned to the ocean. This would entail additional engineering and cost to insure proper drainage of the effluent into the sewage system.

7. The drained material would then be left to dewater which could possibly take longer than one year. During this time period anaerobic decomposition of the organics in the material is likely to give off objectionable odors.

8. The dredged material after being dewatered would still be polluted. This would mean special containment of the material would be necessary to prevent leaching of the pollutants into water supplies or ground water. Discussions with Massachusetts Department of Environmental

Quality Engineering indicate that there are no existing disposal sites within communities in the region of the project site which meet the criteria for disposal of polluted waste. Therefore a sealed containment area would need to be designated by the DEQE in conjuntion with the local board of health for 33,000 cubic yards of material.

9. Disposal of material for development purposes is not practical due to the poor structural properties of the material. Without substantial soil improvement efforts the bearing capacity of the material would not be suitable for further development purposes.

10. Even if all of the engineering and environmental problems were overcome the cost of construction would make the project unfeasible. The non-Federal cost share would be severely increased because all of the costs associated with disposal would be the responsibility of the local sponsor due to Federal cost sharing requirements.

MARSH CREATION

11. The creation of salt marsh was studied to assess it's acceptability as a disposal alternative. In order to impliment this alternative the disposal area must be large and subject to daily tidal action. The only area which meets this criteria is the Mill Cove Tidal Flats.

12. There are two major environmental impacts which would result. First, valuable tidal flat areas with productive shellfish beds would be distroyed. Second, because you would need to hydraulically dredge the material the same pollution problems incountered with upland disposal would occur. However, the water would be drained back into the river.

OCEAN DISPOSAL

13. At present, the Boston Foul Area is the only designated location off the Massachusetts coast where the ocean disposal of dredged material is permitted. It is located approximately 29 nautical miles from the Weymouth Fore River. The area is approximately 1 nautical mile in diameter with a center point at 42^{o} 25' N latitude, 70^{o} 35' W longitude. Water depths at the site range from 270 feet to 300 feet. See plate 4.

14. The currents at all depths in the Boston Foul Area fluctuate considerably in both direction and speed with the bottom currents being consistently weaker than those measured at mid-depth and near the surface. Along the sea floor the residual drift is southeasterly in January, consistently westerly during June, mostly easterly in September, and variable bout somewhat northly in October.

15. Studies for the Commonwealth of Massachusetts and the Corps of Engineers on the Foul Area show that it is polluted with PCB's and heavy metals. The area has been used as a disposal site most recently for the Charles River Dam which was highly contaminated (see the Environmental Assessment table 2).

16. The offshore benthic population in the fine-grained substrates of Massachusetts Bay can best be characterized as a spio filicornisthyosira (gouldi) community. In the Boston Foul Area, the number of species and individuals are relatively depressed as compared with the entire area. Since this is not biologically productive, the dumping of dredged material will not have any severe impacts on the biologic community.

17. Analysis of the sediments from the Weymouth - Fore river shown in tables 6-1 to 6-8 indicate the material is fine silt and clay. The chemical analysis of the material indicated that there are relatively high amounts of heavy metals and oil and

grease. The elutriate test results (Table 2 of the environmental assessment) indicate potential toxins which could be released in the water at the disposal site. It should be remembered that the elutriate tests are performed using 4 parts of water to 1 part of sediment. This is a realistic comparison if the material is to be hydraulically dredged. However, for ocean disposal, the material will be dredged with a clam shell dredge and placed into a barge. The volume of water to sediment will then be less than 4 to 1, in fact studies indicate that this volume can be less than a 1 to 1 ratio. Furthermore, when disposal occurs at the Foul area, the material will not behave as individual small particles, rather it will act as a mass, thus settling quite rapidly.

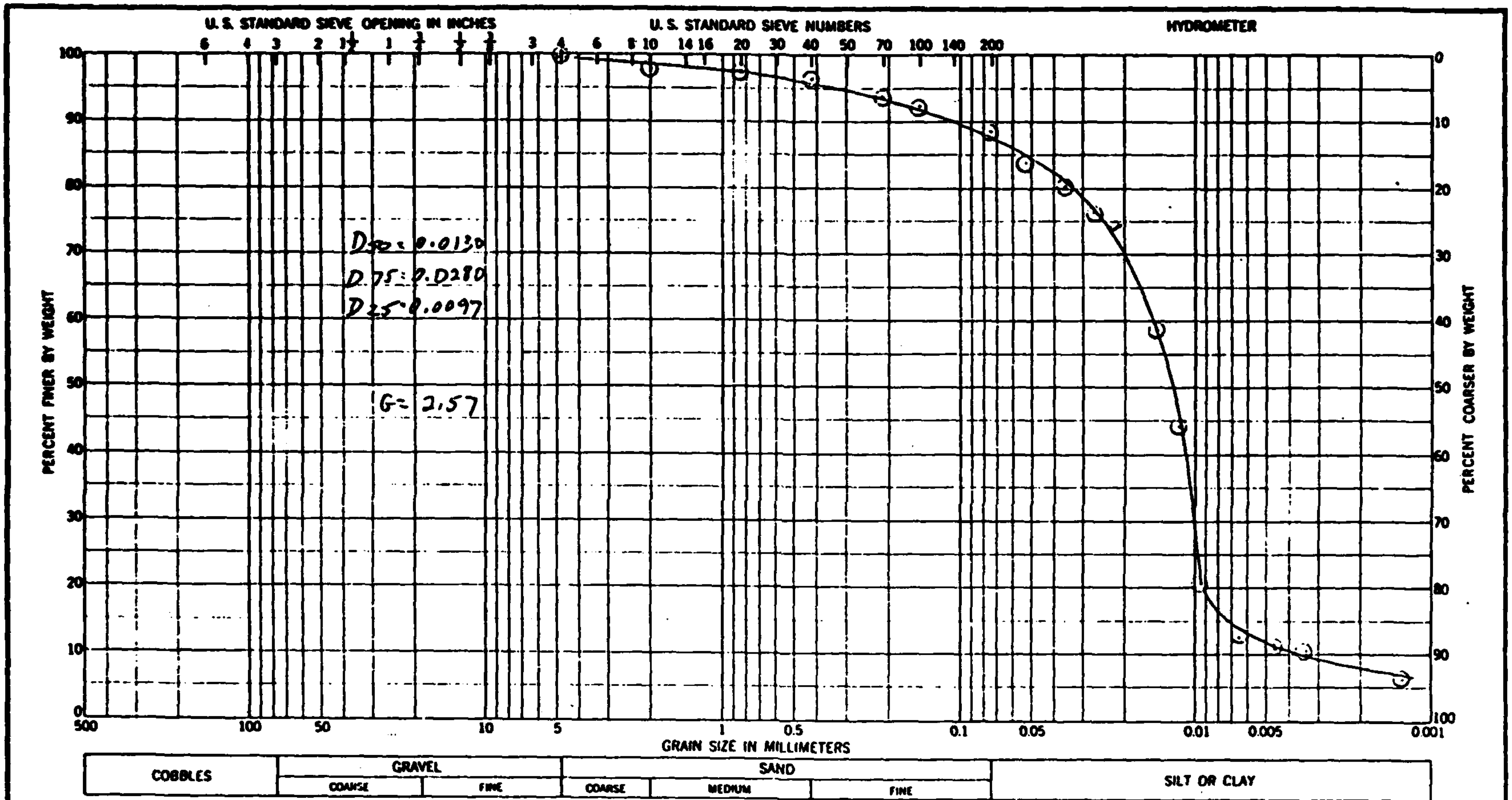
18. Section 103 of the Marine Protection Research and Sanctuaries Act of 1972 (Public Law 92-532) requires that any proposed dumping of dredged material into ocean waters must be evaluated to determine it's potential environmental effects on marine organisms. This appendix contains the detailed bioassay study from the Weymouth Fore River. Results of this bioassay indicate no adverse impact is expected to result from disposal at the Boston Foul Area.

SUMMARY

19. From this analysis it is reasonable to conclude that the first three disposal alternatives are unacceptable from either an environmental, engineering, or economic standpoint. Therefore, ocean disposal at the Boston Foul Area is the only acceptable alternative.

WEYMOUTH FORE RIVER, WEYMOUTH BRAINTREE MASSACHUSETTS
BULK SEDIMENT ANALYSIS

SAMPLE NUMBER	1	2	3	4	5	6
PPM OIL & GREASE	4800.0	598.0	4680.0	2800.0	2990.0	5750.0
PPM MERCURY	1.1	1.0	1.2	1.3	2.2	1.8
PPM LEAD	208.0	51.0	150.0	128.0	129.0	230.0
PPM ZINC	419.0	263.0	304.0	271.0	330.0	368.0
PPM ARSENIC	11.0	12.0	11.0	9.0	9.0	10.0
PPM CADMIUM	8.8	3.7	4.3	5.6	5.5	7.7
PPM CHROMIUM	92.0	41.0	100.0	99.0	87.0	84.0
PPM COPPER	137.0	59.0	144.0	125.0	118.0	166.0
PPM NICKEL	73.0	44.0	70.0	73.0	63.0	46.0
PPM VANADIUM	260.0	140.0	350.0	210.0	100.0	170.0



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
T1	0.0' - 4.5'	f. Sandy Organic CLAY (OH)	128.6	87	36	51
				*59	42	17
		*Note: Oven Dried @ 140°F				

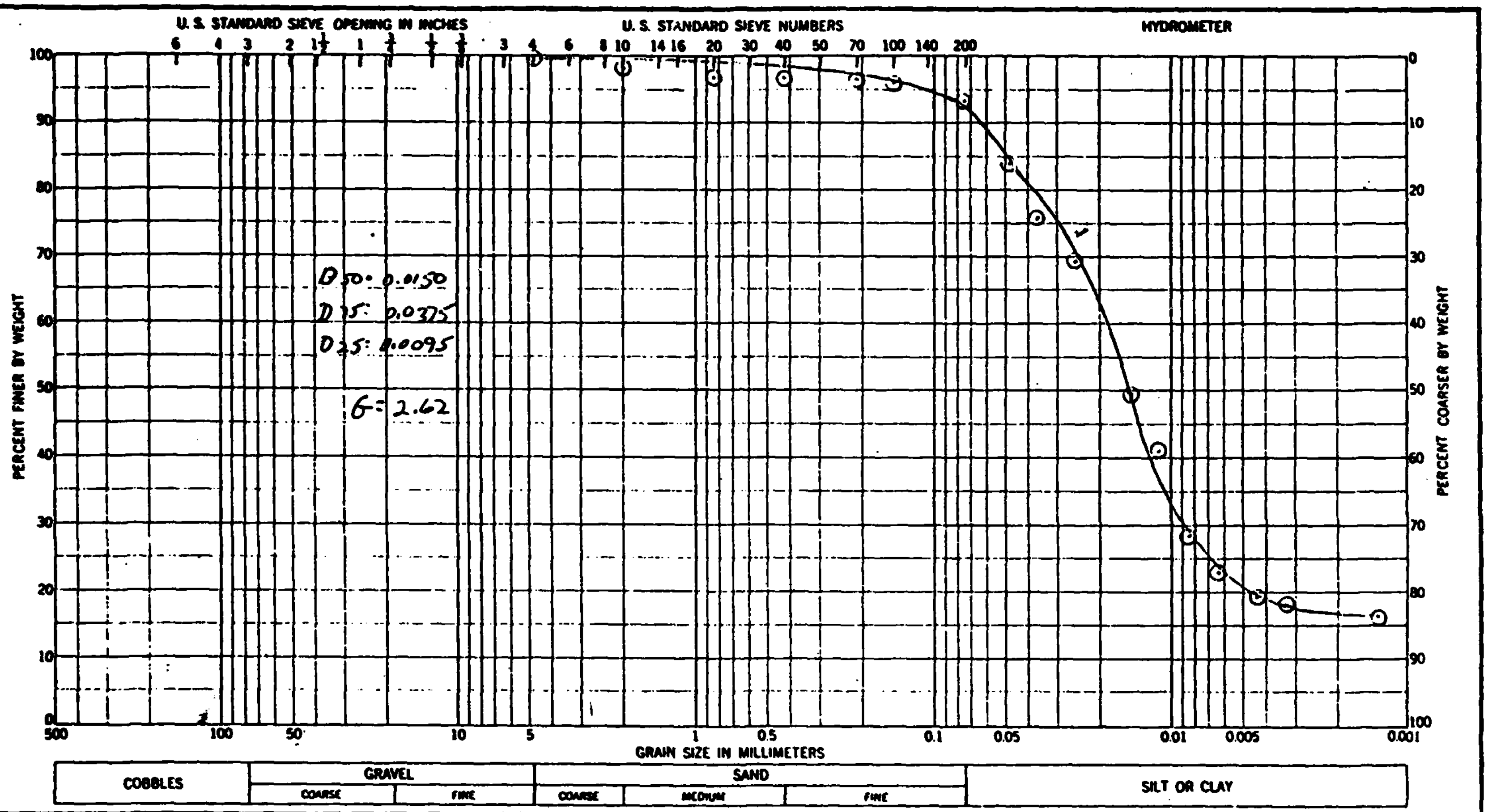
GRADATION CURVES

Project: Fore River
Weymouth, Mass.
Area
Boring No. PE1-79 (Lab Ser. No. 100-293-1D)
Date: March 1979

62

ENG FORM 1 MAY 63 2087

GPO 926-250



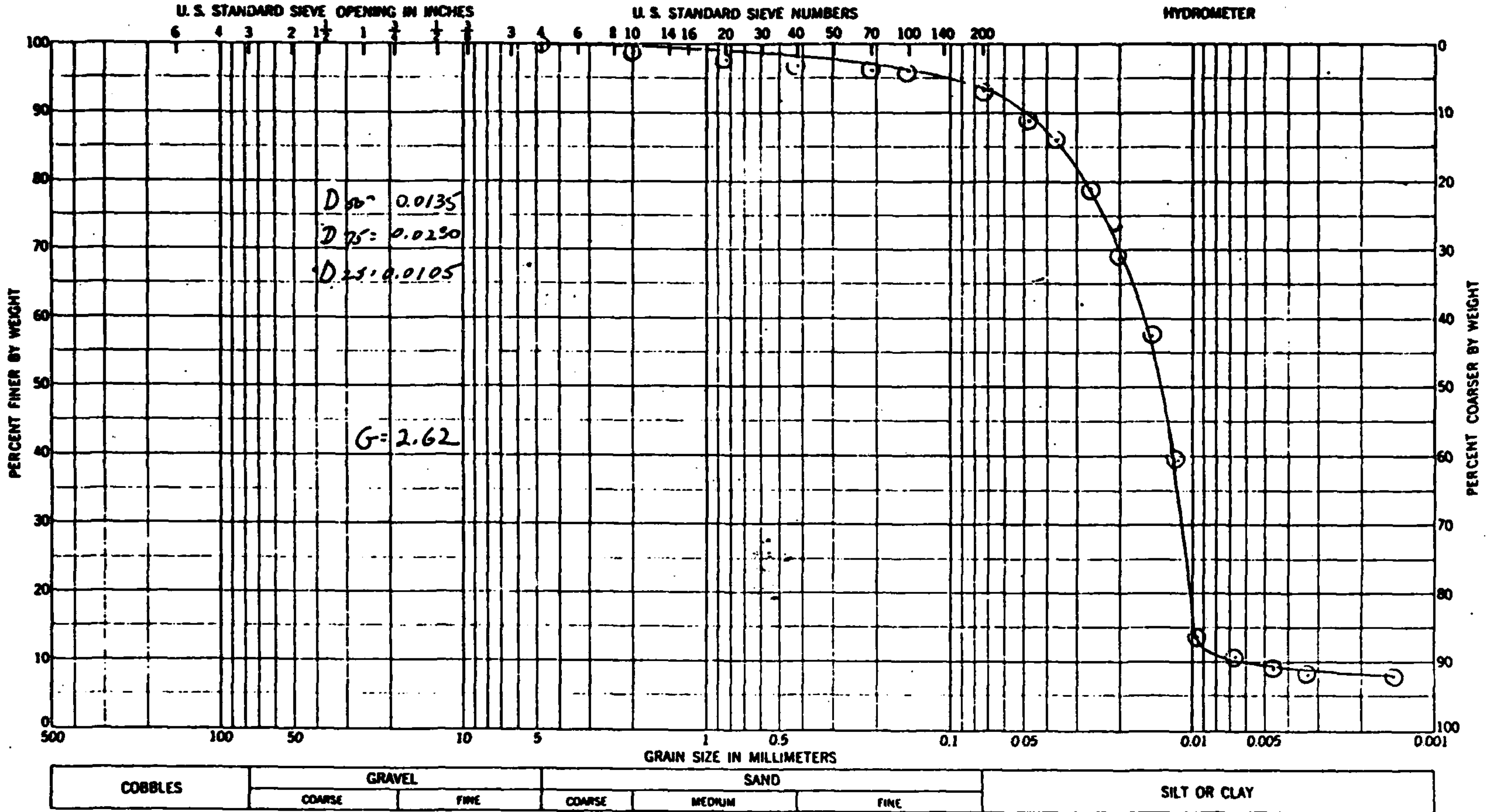
Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
T1	0.0'-1.3'	Organic SILT (OH)	102.1	83	39	44

Project Fore River
Weymouth, Mass
Area
Boring No. PE2-79 (Lab. Ser. No. 100-273-CB)
Date March 1977 6-9

GRADATION CURVES

ENG FORM 1 MAY 63 2087

GPO 9?? ?0



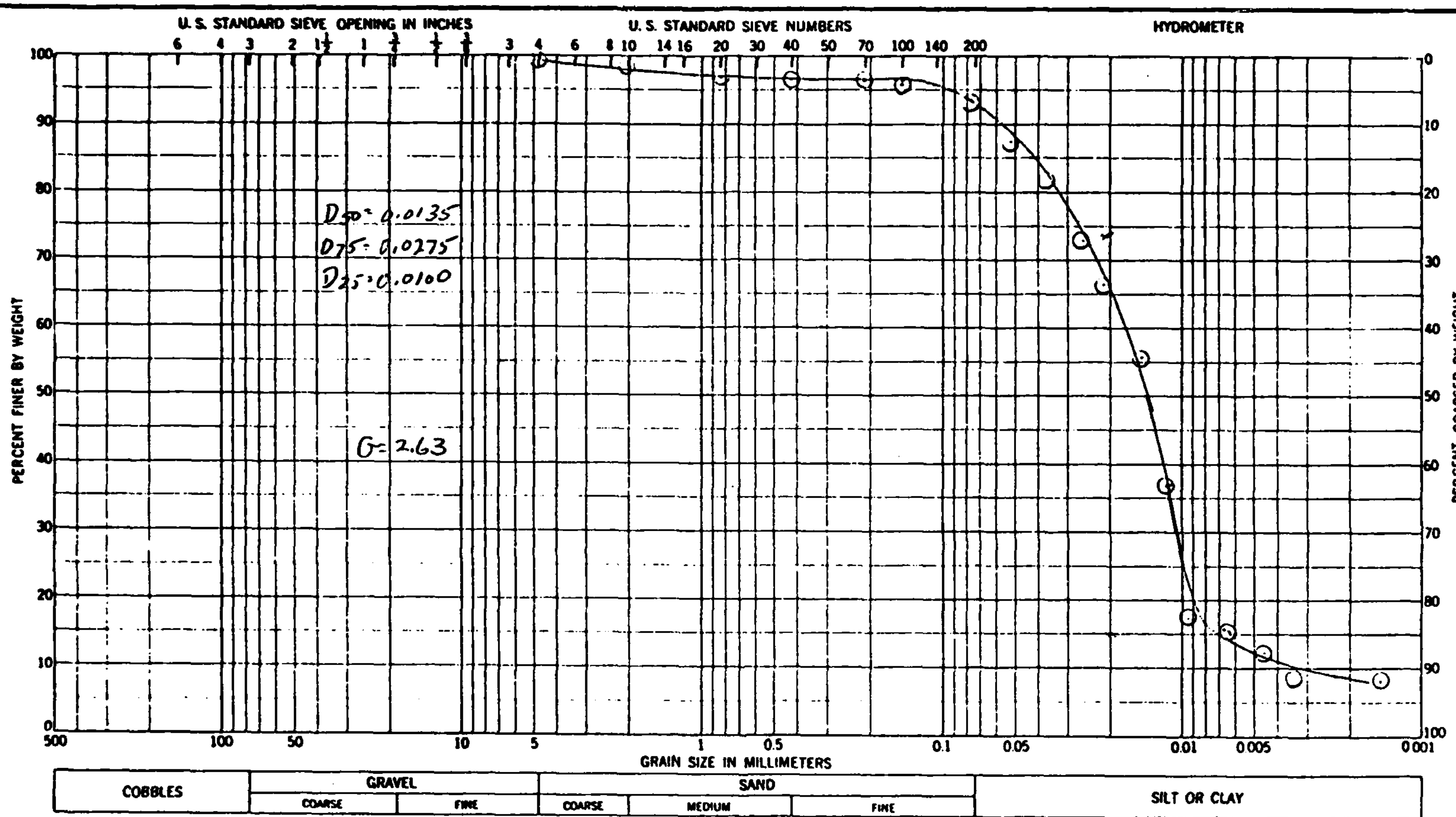
Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
T2	0.0' - 3.8'	f. Sandy Organic CLAY (OH)	142.9	86	36	50

Project: Fore River
Weymouth, Mass.
Area:
Boring No. PE 3-79 (Lab. Serial: 100-293-12B)
Date: March 1979
6-5

GRADATION CURVES

ENG FORM 2087, 1 MAY 63

GPO 926-250



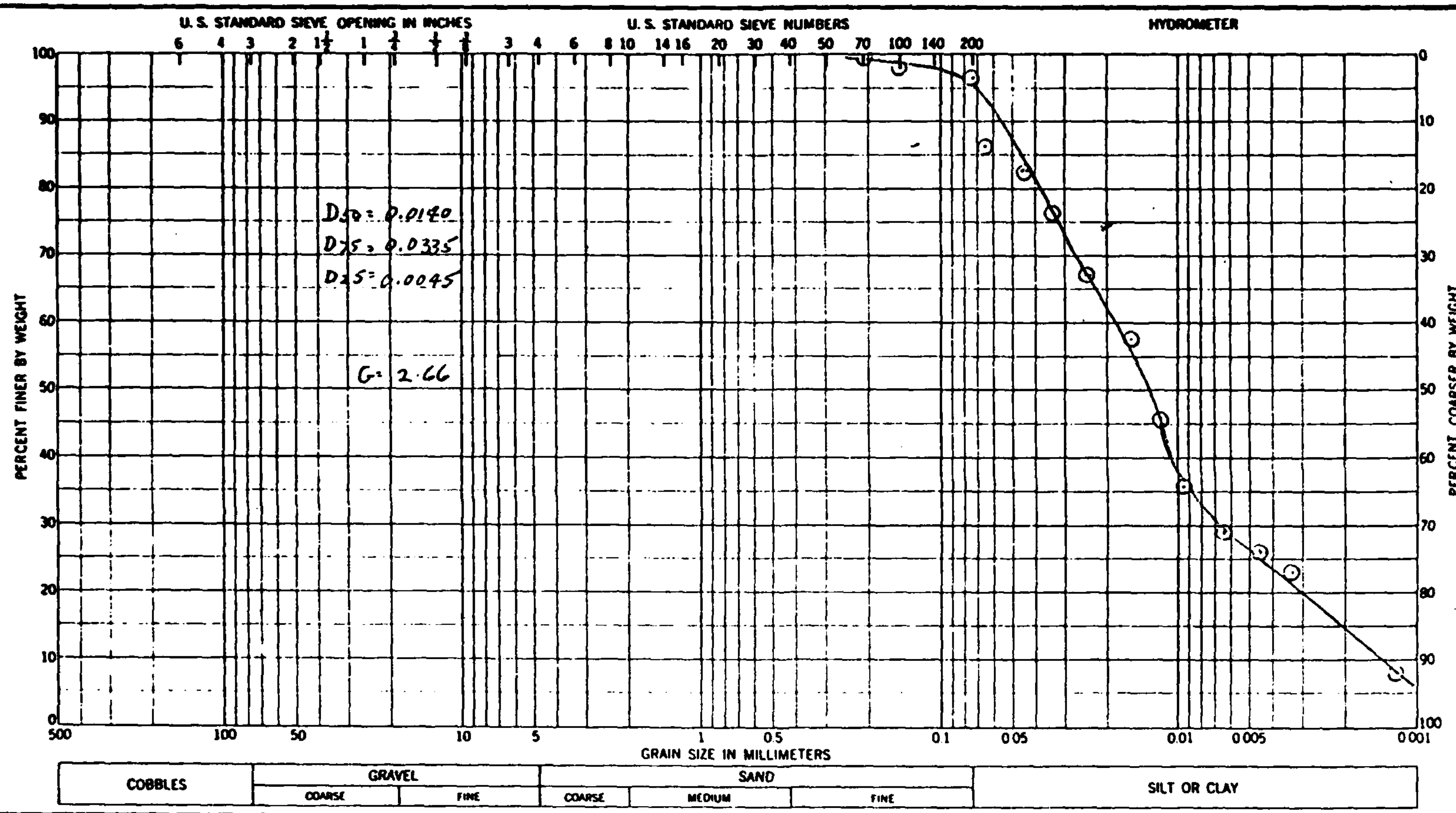
Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
T2	0.0 - 4.75'	f. Sandy Organic CLAY (OH)	135	86	37	49

Project: Fore River
Weymouth, Mass
Area
Boring No. PE4-79 (Lab. Ser. No. 130-293-148
Date: March 1979
6-6

GRADATION CURVES

ENG FORM 1 MAY 63 2087

GPO 926-250



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
T1	0.0'-1.3'	Organic CLAY (OH)	123.6	81	34	47

GRADATION CURVES

Project: Fore River, Weymouth, Mass.

Area:

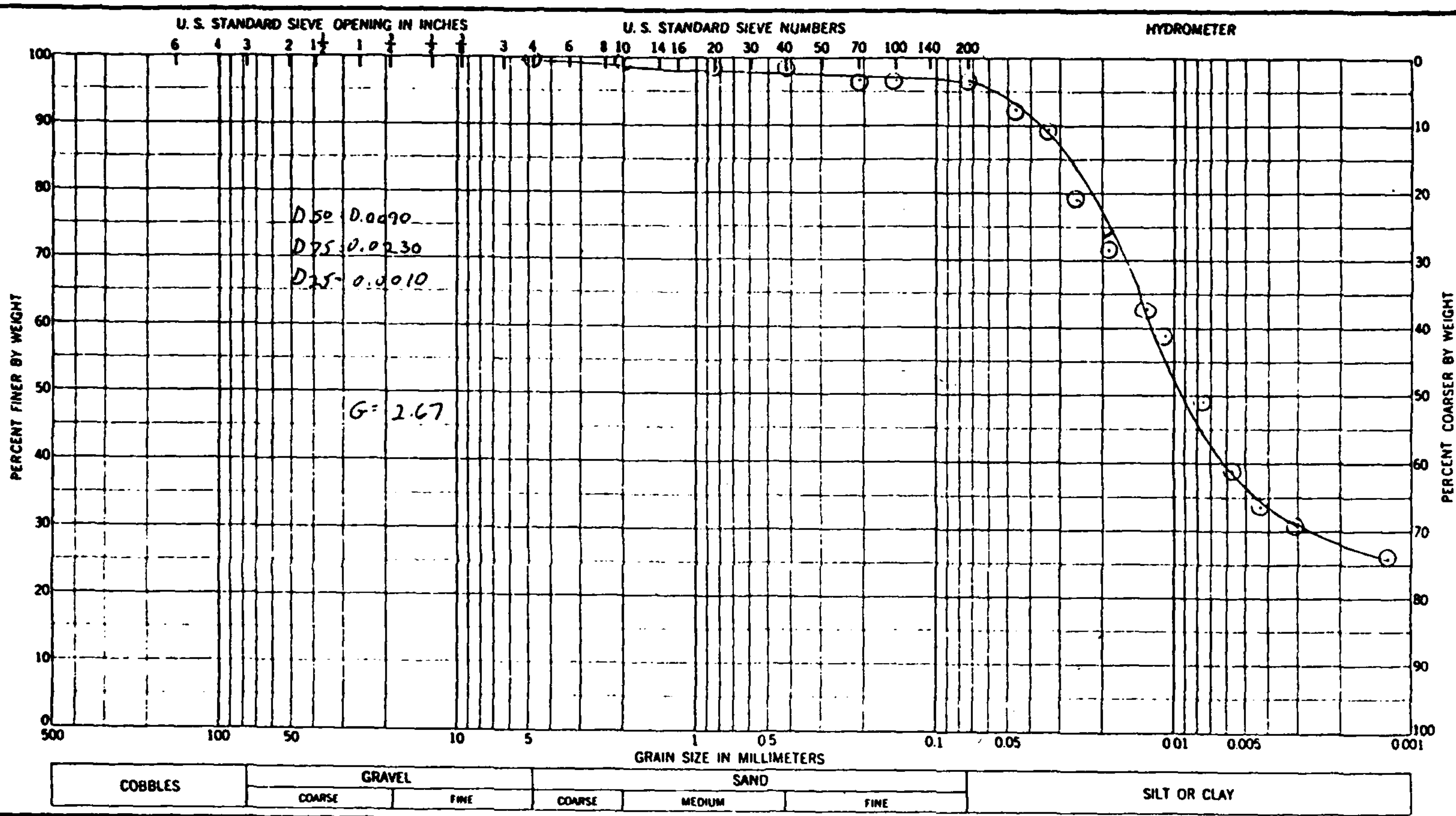
Boring No. PE5-79 (Lab Ser. No 100-293-15B

Date: March 1979

6-4

ENG FORM 1 MAY 63 2087

GPO 920-250



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
T1	1.3'-3.1'	Organic SILT (OH)	96	83	38	45

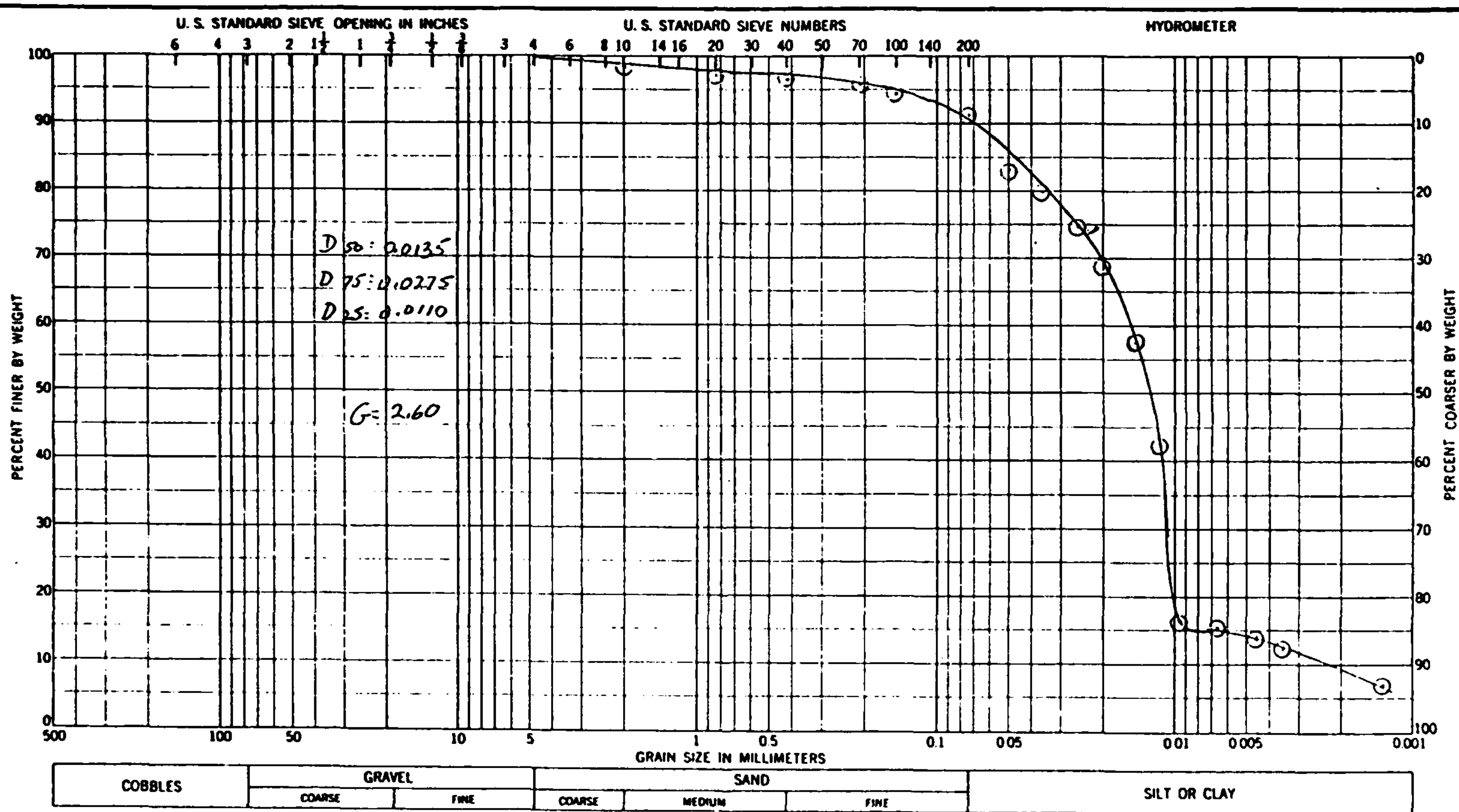
Project Fore River
Weymouth, Mass.
Area
Boring No. PES-79 (Lab. Ser. No 100-293-15D)
Date March 1979

6-8

GRADATION CURVES

ENG FORM 1 MAY 63 2087

GPO 926-250



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
J1	0.0' - 1.3'	f. Sandy Organic Clay (OH)	138	84	37	47

Project Fore River
Weymouth, Mass.

Area

Boring No. PEG-79 (Lab Ser. No 100-293-173)

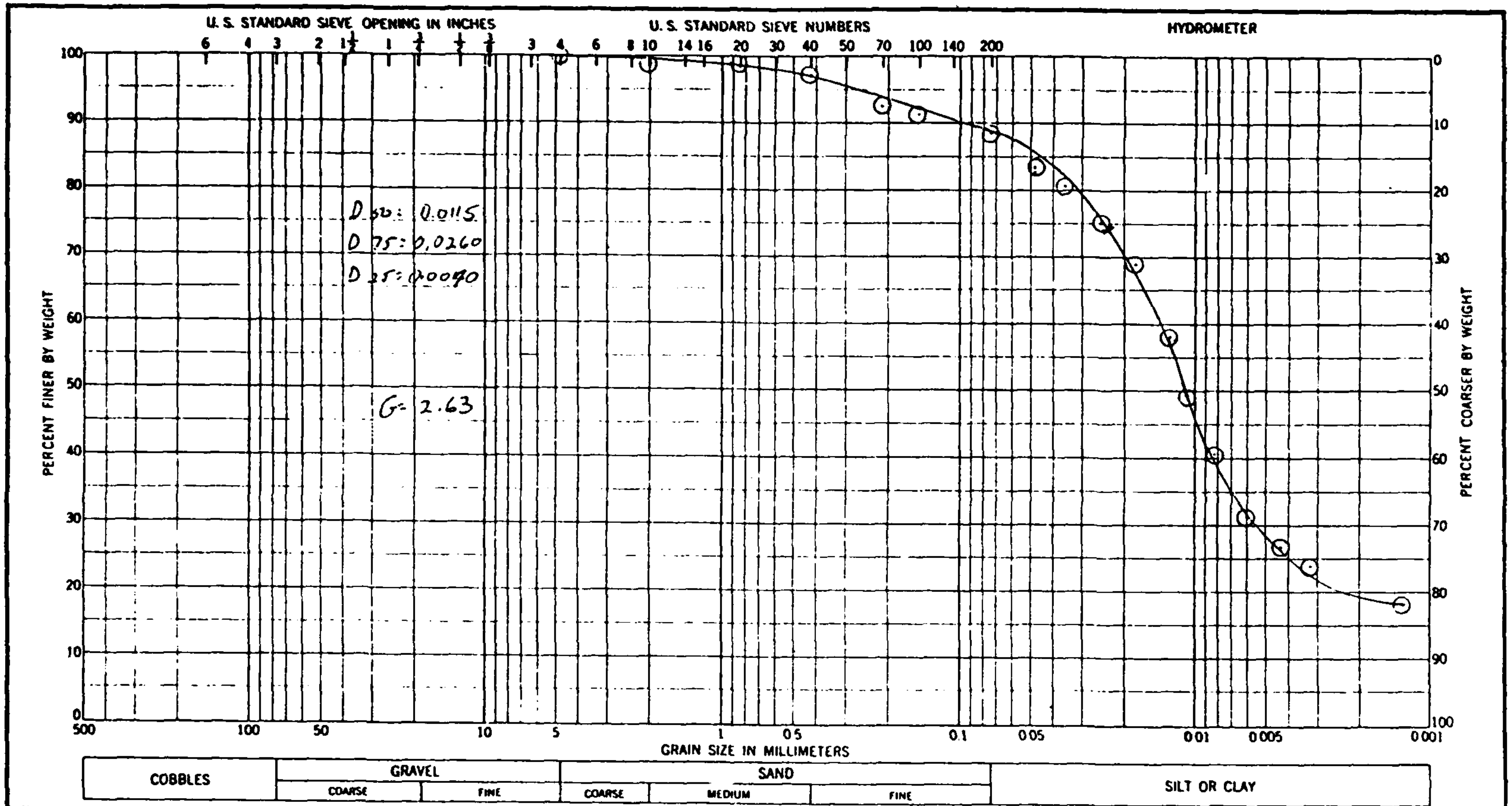
Date March 1979

6-9

GRADATION CURVES

ENG FORM 1 MAY 63 2087

GPO 926-250



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
T1	1.3' - 4.05'	fine Sandy Organic Clay (OH)	103	80	36	44

Project: Fore River
Weymouth, Mass.

Area:

Boring No. PE6-79 (Lab. Ser. No. 100-293-17D)

Date: March 1979

6-10

GRADATION CURVES

ENG FORM 1 MAY 63 2087

GPO 926-250

ECOLOGICAL EVALUATION OF PROPOSED OCEANIC DISCHARGE OF DREDGED MATERIAL FROM WEYMOUTH FORE RIVER, MASSACHUSETTS

-- Contract No. DACW33-79-C-0063 --
Delivery Order No. 7

Prepared for:

New England Division, Corps of Engineers
Department of the Army
424 Trapelo Road
Waltham, Massachusetts 02154
Attention: NED Materials Testing Laboratory

Prepared by:

Environmental Sciences Division
Energy Resources Company Inc.
185 Alewife Brook Parkway
Cambridge, Massachusetts 02138

January 1981

ACKNOWLEDGEMENTS

This evaluation was directed by Dr. Curt D. Rose, Manager, Environmental Sciences Division, Energy Resources Co. Inc. (ERCO). Ms. Christine P. Smith, Aquatic Toxicologist, observed the collection of sediment. Mr. Timothy J. Ward, Director, Aquatic Toxicology Laboratory, Mr. Robert L. Boeri, Aquatic Toxicologist, and Ms. Smith prepared sediment and water for toxicity tests (bioassays) and conducted the bioassays. Mr. Keith A. Hausknecht, Director, Metal Chemistry Laboratory, and Mr, David L. Fiest, Manager, Marine Organic Chemistry Laboratory, supervised analyses of biological tissues for metals and organics, respectively.

SUMMARY

The proposed oceanic discharge of dredged material from Weymouth Fore River, Massachusetts, to the Boston Dump Site is ecologically acceptable as judged by the toxicity- and bioaccumulation-related criteria employed in this evaluation. Survival of copepods (*Acartia clausi*), mysid shrimp (*Neomysis americana*), and Atlantic silversides (*Menidia menidia*) exposed for 96 hr to 100% liquid and suspended particulate phases of dredged material was not significantly lower ($\alpha = 0.05$) than survival of the same organisms exposed for 96 hr to a culture water control. Also, total (combined) survival of grass shrimp (*Palaemonetes pugio*), hard clams (*Mercenaria mercenaria*), and sandworms (*Nereis virens*) exposed for 10 days to reference (disposal-site) sediment and the solid phase of dredged material was not significantly different. In addition, tissues of grass shrimp, hard clams, and sandworms that survived exposure to the solid phase of dredged material did not contain significantly elevated ($\alpha = 0.05$) concentrations of xenobiotic constituents (cadmium, mercury, polychlorinated biphenyls [PCBs], the dichloro- diphenyl-trichloroethane [DDT] family, and petroleum hydrocarbons), as compared to tissues of reference organisms.

TABLE OF CONTENTS

1. INTRODUCTION

The major objective of this evaluation is to assess the ecological acceptability of the proposed oceanic discharge of dredged material from Weymouth Fore River, Massachusetts, to the Boston Dump Site (Figure 1). If the proposed discharge is judged to be ecologically acceptable according to the bioassay- and bioaccumulation-related criteria employed in the evaluation, the disposal practice is considered to be in partial compliance with Subpart B (Environmental Impact) of the ocean dumping regulations (U.S. EPA, 1977).

Subpart B (Environmental Impact) of the ocean dumping regulations consists of the following basic sections: §227.5 (Prohibited Materials); §227.6 (Constituents Prohibited as Other than Trace Contaminants); §227.7 (Limits Established for Specific Wastes or Waste Constituents); §227.8 (Limitations on the Disposal Rates of Toxic Wastes); §227.9 (Limitations on Quantities of Waste Materials); §227.10 (Hazards to Fishing, Navigation, Shorelines or Beaches); §227.11 (Containerized Wastes); §227.12 (Insoluble Wastes); and §227.13 (Dredged Materials). Disposal of dredged material must comply with restrictions and limitations imposed by §227.5, §227.6, §227.9, §227.10, and §227.13 of the regulations (U.S. EPA, 1977).

Dredged material from Weymouth Fore River complies with §227.5 (Prohibited Materials) of the ocean dumping regulations since it does not contain high-level radioactive wastes; materials used for warfare; insufficiently described materials; or persistent, inert substances that may interfere materially with legitimate uses of the ocean. Compliance of the material with toxicological (bioassay-based) and bioaccumulation-related criteria identified in §227.6 (Constituents Prohibited as

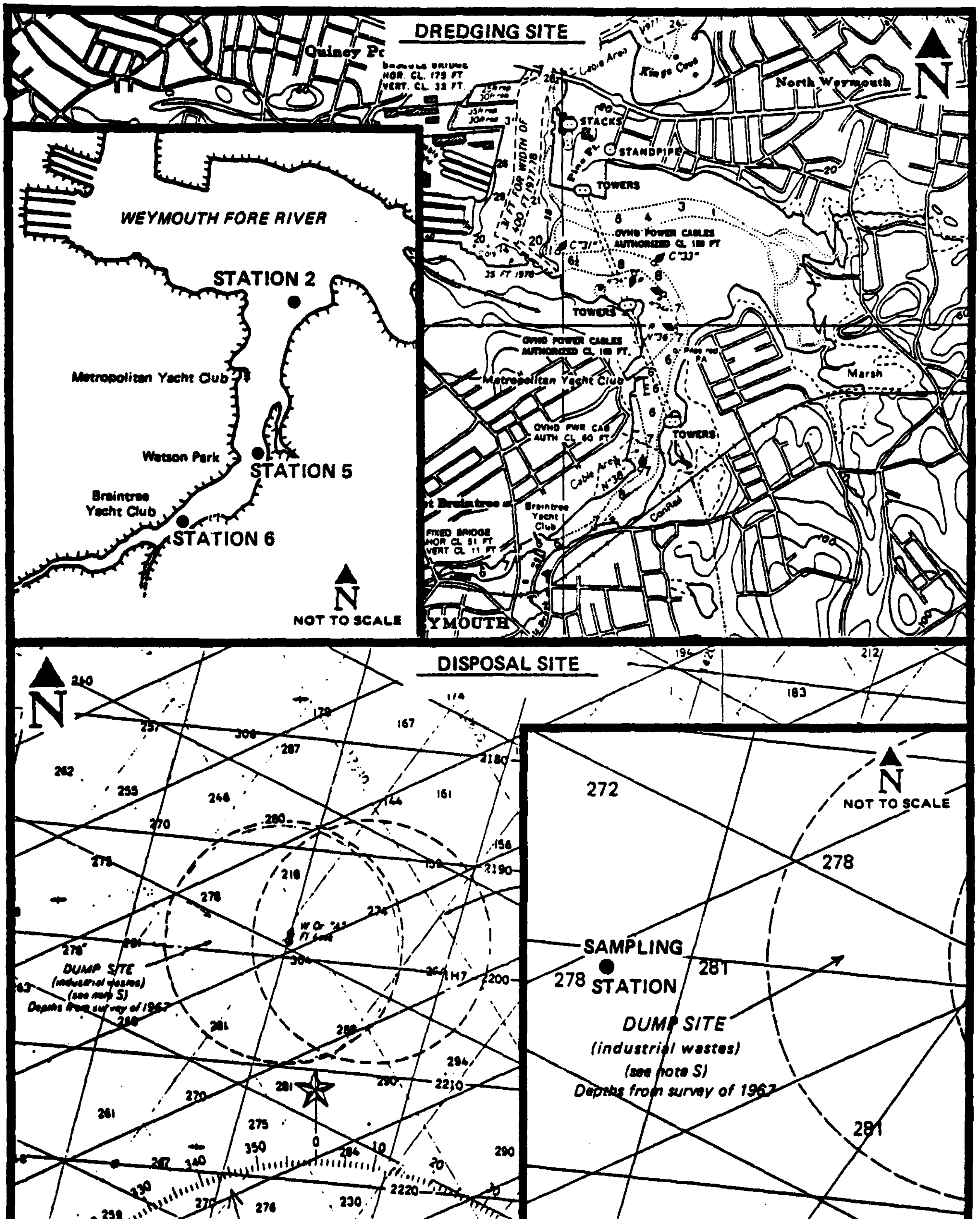


Figure 1.—Locations of proposed dredging site and disposal site. Sampling stations for sediment are depicted in insets

Other than Trace Contaminants) and §227.13 (Dredged Material) of the regulations is addressed in this evaluation.

The evaluation consists of four principal sections in addition to the Introduction. The first section, which precedes the Introduction, summarizes the ecological acceptability of the proposed discharge operation. The second section reviews the methods and materials employed in the evaluation. The third section presents important results of the evaluation. The fourth section contains references cited in the evaluation.

The evaluation contains two appendices. Appendix A details laboratory procedures employed for preparing dredged material and conducting bioassays. The appendix also serves as a quality-control document. Appendix B contains all raw bioassay-related data. Only data directly relevant to the ecological evaluation of the proposed discharge operation are presented in the main body of the evaluation.

2. METHODS AND MATERIALS[1]

Dredged material proposed for oceanic discharge was collected from three sampling stations in Weymouth Fore River (Figure 1) during 1115-1145 on November 3, 1980, and 1145-1515 on November 6, 1980. Material was collected from an unnamed vessel (operated by Mr. J. Pedoto) on November 3, and from the vessel Blue Chip on November 6 by R. Clark and E. Doubleday of the New England Division of the U.S. Army Corps of Engineers. C. Smith of ERCO observed the collection efforts.

The first station (Station 2) was located approximately 300 m northeast of the Metropolitan Yacht Club dock, Braintree, Massachusetts. The second station (Station 5) was situated approximately 50 m from the east bank of the river, 300 m southwest of the termination of Biscayne Avenue, Weymouth, Massachusetts. The third station (Station 6) was located approximately 60 m from the west bank of the river adjacent to the southern end of a stone wall surrounding Watson Park, Braintree, Massachusetts. Water depth at all stations ranged from 1 to 3 m. At each station, seven to eight core samples were collected with a plastic piston environmental sampler. Each core sample (encased in a clear plastic tube) was assigned an identification number (Station 2, Station 5, and Station 6). The tubes were sealed with yellow plastic caps and transported to ERCO's Aquatic Toxicology Laboratory in Cambridge, Massachusetts. At the laboratory, samples from each station were composited, mixed, and stored in plastic bags at 2-4°C. Samples were placed in cold storage at 1700 on November 3, 1980, and at 1600 on November 6, 1980.

[1]Laboratory procedures used to prepare dredged material and conduct bioassays are described in detail in Appendix A of this evaluation.

Dredged material was prepared for biological testing according to procedures described in Appendix B of the manual entitled Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters (U.S. EPA and U.S. Army COE, 1977). Artificial seawater (30 ppt salinity) was employed to formulate liquid and suspended particulate phases of dredged material. During preparation of the liquid and suspended particulate phases, dredged material and artificial seawater were mixed by mechanical methods (as opposed to mixing by compressed air) since anoxic conditions did not occur in the sediment-seawater mixtures. In preparation of the liquid phase, centrifugation was not required to reduce concentrations of suspended solids prior to filtration.

Bioassays with dredged material were, with one exception, conducted according to guidelines presented in Appendices D and F of the EPA and COE manual for dredged material (U.S. EPA and U.S. Army COE, 1977). The one exception is that 19-liter aquaria, rather than 38-liter aquaria, were used to conduct liquid and suspended particulate phase bioassays with fish. The use of the smaller aquaria is sanctioned by the EPA in its contemporary procedures for performing bioassays for the Ocean Dumping Permit Program (U.S. EPA, 1978).

Species employed in the liquid and suspended particulate phase bioassays were the copepod (*Acartia clausi*), mysid shrimp (*Neomysis americana*), and Atlantic silverside (*Menidia menidia*). All organisms were purchased from a commercial supplier in Salem, Massachusetts, and acclimated in artificial seawater for at least 3 days prior to use in bioassays. Bioassays were conducted at 20±1°C, the recommended summer testing temperature for the New England region (U.S. EPA and U.S. Army COE, 1977). Artificial seawater was used to dilute liquid and suspended particulate phases to appropriate test concentrations and as a control (culture water control).

Species tested in the solid phase bioassays were the grass shrimp (*Palaemonetes pugio*), hard clam (*Mercenaria mercenaria*), and sandworm (*Nereis virens*). Grass shrimp, hard clams, and sandworms were acquired from commercial suppliers in, respectively, Salem, Massachusetts; Long Island, New York; and Boston, Massachusetts. Animals were acclimated in artificial seawater for at least 3 days prior to initiation of testing. All species were tested in the same aquaria. Testing temperature was again 20 ± 1°C. Water exchange (artificial seawater) was by the replacement, as compared to the flow-through, method. Control (culture) sediment employed in the tests was collected on November 13, 1980, from the subtidal zone off Manchester, Massachusetts. The sediment, which was collected by R. Boeri and C. Smith, ERCO, consisted primarily of sand. Reference (disposal-site) sediment used in the tests was collected during the morning of November 14, 1980, from a single sampling station located approximately 3 km west of the "A" buoy in the Boston Dump Site (Figure 1). The sediment was collected with a Van Veen grab operated from the vessel *Bobby L* by R. Clark and E. Doubleday. C. Smith of ERCO observed the collection. Depth of water at the sampling station was approximately 75-80 m. The sediment was put in plastic bags and placed in cold storage (2-4°C) at ERCO's Aquatic Toxicology Laboratory on November 14, 1980.

Mysid shrimp exposed to liquid and suspended particulate phases of dredged material were fed live 48-hr-old *Artemia* (brine shrimp) nauplii at a rate of approximately 1 ml of culture/1,000-ml crystallizing dish/day. Other organisms were not fed immediately before or during testing.

At the conclusion of the solid-phase bioassays with grass shrimp, hard clams, and sandworms, all surviving organisms from each aquarium (replicate) were placed in an aquarium

containing clean, sediment-free water and allowed to void their digestive systems (sand worms were confined in Nitex containers to prevent predation by grass shrimp). Organisms were maintained in uncontaminated media for a period of 2 days. During this time, fecal material was removed from aquaria. At the end of the 2-day period, all samples of organisms were split into approximately equal amounts. One of these subsamples was placed in a polyethylene clean bag and frozen for later analyses for metals. The second subsample was put in solvent-rinsed aluminum foil and frozen for analyses for organics. Prior to being chemically analyzed, biological samples were thawed and exoskeletons of grass shrimp and hard clams were removed with acid-rinsed plastic utensils (metal analyses) or solvent-rinsed metal utensils (organic analyses).

Biological samples (tissue samples) were analyzed for two metals - cadmium (Cd) and mercury (Hg) - according to procedures described by Goldberg (1976) and the EPA (1979). In the analyses for Cd, an aliquot of wet, homogenized tissue (approximately 5 g for hard clams and sandworms and 0.3-0.6 g for grass shrimp) was placed in a 100-ml tall-form Pyrex beaker with 5 ml of concentrated, Instra-analyzed (J.T. Baker Co.) nitric acid and refluxed without boiling until the tissue was completely digested (6-24 hr). Following digestion, the sample was evaporated to dryness. Then, additional nitric acid (1-2 ml) and 30% Ultrex (J.T. Baker Co.) hydrogen peroxide (1-2 ml) were added to the beaker, and the sample was heated until oxidative frothing subsided. At this time, the sample was cooled, diluted to volume with deionized, distilled water, and analyzed by graphite-furnace atomic absorption spectrophotometry (AAS). Procedural blanks and standards were evaluated using the same methods employed for tissue samples. For the analyses for Hg, a

separate aliquot of wet, homogenized tissue (about 5 g for hard clams and sandworms and 0.3-0.6 g for grass shrimp) was placed in a 300-ml glass BOD bottle. Approximately 15-20 ml of concentrated, Instra-analyzed sulfuric acid was placed in the bottle and the sample was heated at 55°C in a water bath until the tissue was completely digested (2 hr). After cooling of the sample, 100 ml of deionized, distilled water and 1-2 g of Instra-analyzed potassium permanganate were added to the bottle. The resulting solution was analyzed by cold-vapor AAS after addition of reducing agents (10% hydroxylamine hydrochloride and 10% stannous sulfate). Procedural blanks and standards were assessed by the same methods used for tissue samples.

In the case of Cd, analyses of three samples of oyster tissue from the National Bureau of Standards (NBS-SRM 1566) averaged 3.8 ± 0.4 µg/g dry wt., as compared to a certified value of 3.5 ± 0.4 µg/g. Precision of analytical techniques is indicated by values obtained with subsamples of organisms that were not employed in bioassays - 0.256, 0.132, and 0.151 µg/g wet wt. (hard clams); and 0.050, 0.049, and 0.046 µg/g (sandworms). Procedural blanks contained abnormally high concentrations of Cd. Therefore, tissue samples were not corrected for the blanks. In the case of Hg, analyses of three samples of oyster tissue averaged 0.041 ± 0.002 µg/g dry wt., as compared to a certified value of 0.057 ± 0.015 µg/g. Precision of analytical techniques is again evidenced by values associated with subsamples of organisms not used in bioassays - 0.012, 0.010, and 0.014 µg/g wet wt. (hard clams); and 0.001, <0.001, and 0.001 µg/g (sandworms). Procedural blanks contained an average equivalent of 0.025 µg/g wet wt. (grass shrimp), 0.001 µg/g (hard clams), and 0.001 µg/g (sandworms).

Tissue samples were analyzed for three types of organics - polychlorinated biphenyls (PCBs), the dichloro-diphenyl-trichloroethane family (DDT, DDE, and DDD), and petroleum hydrocarbons - according to procedures described by the EPA (1971), Crump-Wiesner et al. (1974), the Food and Drug Administration (1977), and Warner (1976). Tissue samples (5-20 g wet wt.) were placed in 50-ml centrifuge tubes, to which were added 10-ml aliquots of 10 N potassium hydroxide and high-purity methanol, and 5 μg of an internal standard (androstane). After sealing with nitrogen gas, the tubes were placed in a water bath at 80°C for 4 hr (tubes were shaken every 30 min). This saponification process, described above, digests the tissue, thereby releasing DDTs, PCBs, and petroleum hydrocarbons. Three 20-ml portions of high-purity hexane were used to extract the original compounds of interest from the methanol/potassium hydroxide digestate. The water soluble fraction was then discarded. The three extracts were combined, dried over a small volume (10 g) of sodium sulfate, and concentrated to 1 ml by flash evaporation. The extracts were then fractionated using column chromatography (1 g sodium sulfate, 6.5 g of 7.5% deactivated alumina, and 1 g sodium sulfate) as follows: the 1-ml concentrate was charged to the top of the column and the column was eluted with 25 ml of hexane. The hexane was concentrated to 2 ml by flash evaporation, and further concentrated to 0.5 ml under a stream of purified nitrogen. The hexane fraction (f_1) was analyzed for PCBs and the DDT family by packed-column gas chromatography and electron-capture detection, employing a Hewlett-Packard Model 5840A instrument equipped with a Ni^{66} detector. The column, a 6-ft x 2-mm I.D. glass instrument packed with 5% SP2401 or 1.95% SP2401 and 1.5% SP2250, was held isothermally at 188°C. The peaks in the f_1 fraction were identified and quantified by comparing retention times and peak areas to those of standards. An aliquot of the fraction was analyzed for petroleum hydrocarbons

by glass capillary gas chromatography and flame ionization detection, employing a Hewlett-Packard Model 5840A instrument. The column, a 0.25-mm I.D. x 30-m SE30 glass capillary fused silica column (J&W Scientific), was temperature-programmed from 60°C to 275°C at 10°/min. The areas of the resolved and unresolved components were measured by electronic integration and planimetry, respectively, and compared to the areas of an internal standard (androstane) to determine the concentration of petroleum hydrocarbons.

In the analyses for PCBs, procedural blanks contained less than the detection limit (0.01 µg/g wet wt.) for all species. Precision of analytical techniques is indicated by values obtained with subsamples of organisms that were not employed in bioassays - 0.01 and 0.01 µg/g wet wt. (grass shrimp); 0.01, 0.01, and <0.01 µg/g (hard clams); and <0.01 and 0.01 µg/g (sandworms). In the analyses for the DDT group, procedural blanks, as well as all samples, contained less than detectable levels of the chemicals (0.01 µg/g wet wt.). In the case of petroleum hydrocarbons, procedural blanks for grass shrimp contained an average of 0.7 µg/g wet wt., and blanks for hard clams and sandworms contained an average of 1.3 µg/g. Precision of analytical techniques is again indicated by values obtained with subsamples of organisms not employed in bioassays - 4.5, 6.1, and 8.3 µg/g wet wt. (hard clams) and 2.8, 3.4, and 3.9 µg/g (sandworms).

Results of the bioassay and bioaccumulation studies were interpreted by statistical techniques recommended by the U.S. EPA and U.S. Army COE (1977). When warranted, each data set generated in the studies was evaluated by Cochran's test to determine if variances of the data were homogeneous. If variances were homogeneous, a parametric unpaired "t" test was used to determine if significant

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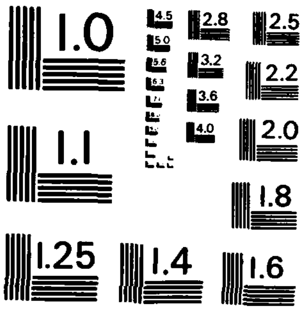

MICROCOPY RESOLUTION TEST CHART
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differences exist between control or reference organisms and organisms exposed to dredged material. If variances of the data were not homogeneous as judged by Cochran's test, the data were evaluated for significant differences by an approximate (nonparametric) unpaired "t" test. In all statistical tests, the symbols "*(*)" and "ns" are used to denote significant and nonsignificant differences, respectively.

3. RESULTS

The dredged material employed in the evaluation consisted primarily of gray-black, sandy silt (visual determination). The reference (disposal-site) sediment was similar in texture to the dredged material.

3.1 Bioassay Studies

Bioassay studies performed during the evaluation consisted of liquid and suspended particulate phase bioassays and solid phase tests.

3.1.1 Liquid and Suspended Particulate Phase Bioassays

Analyses of results of liquid and suspended particulate phase bioassays are presented according to the same format since the analyses are based on identical components (U.S. EPA and U.S. Army COE, 1977): (1) selection of an appropriate control for comparison to test results (when disposal-site water as well as culture water is used for control purposes), (2) statistical comparison of survival of organisms exposed for 96 hr to the appropriate control and 100% liquid/suspended particulate phase, (3) calculation or estimation of a "worst-case" exposure-time-dependent LC50 and associated 95% confidence interval for the liquid/suspended particulate phase (if survival in 100% liquid/suspended particulate phase is significantly less than survival in the appropriate control), (4) derivation of an exposure-time-dependent limiting permissible concentration (LPC) for the liquid/suspended particulate phase by multiplying the lower limit of the 95% confidence interval of the worst-case LC50 for the phase by 1% or a pragmatically

determined application factor, and (5) graphical comparison of the LPC for the liquid/suspended particulate phase to the estimated environmental concentration ("dilution curve") of the phase as determined, in all probability, by the release-zone model.

3.1.1.1 Liquid Phase Bioassays

Data produced by liquid phase bioassays with copepods, mysid shrimp, and Atlantic silversides are presented in, respectively, Tables B1, B2, and B3 (Appendix B). Mean survival of organisms exposed for 96 hr to 100% phase was 80.0% (copepods), 50.0% (mysid shrimp), and 93.3% (Atlantic silversides).

Analyses of survival data for copepods, mysid shrimp, and Atlantic silversides exposed for 96 hr to culture water control and 100% liquid phase of dredged material are presented in Tables 1-3, respectively. In the case of all species, mean survival in the culture water control was equal to or greater than 90%, thus permitting further analyses of data.

Survival data for copepods exhibited heteroscedasticity as determined by Cochran's test (Table 1). Consequently, an approximate unpaired "t" test was employed to compare survival data. This test indicates no statistically significant difference ($\alpha = 0.05$) in survival of copepods exposed to culture water control and 100% liquid phase of dredged material. Survival data for mysid shrimp exhibited homogeneity of variances (Table 2). Therefore, a parametric unpaired "t" test was employed to determine if the survival data are characterized by a significant difference. Results of the "t" test indicate no statistically significant difference

Table 1. Analysis of survival data for copepods, *Acartia clausi*, exposed for 96 hr to culture water control and 100% liquid phase of dredged material

Step 1. Survival Data (from Table B1)

Repli-cate (r)	Treat-ment (t):	Number of survivors: Culture water control	Dredged material
1		9	9
2		9	9
3		9	6
	Mean ($\bar{x}$):	9.00 (90.0%)	8.00 (80.0%)

Step 2. Cochran's Test for Homogeneity of Variances of Survival Data

Treatment (t)	Number of survivors: Mean ($\bar{x}$)	Variance(s^2)
Culture water control	9.00	0.00
Dredged material	8.00	3.00

$$C_{(cal.)} = \frac{s^2(max.)}{\Sigma s^2} = \frac{3.00}{3.00} = 1.00 \ *,$$

as compared to: $C_{(tab.)} = 0.98$ for $\alpha = 0.05$, $k = 2$, and $v = 2$

Step 3. Approximate Unpaired "t" Test of Survival Data (Culture Water Control vs. Dredged Material)

$$t'_{(cal.)} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2 + s_2^2}{3}}} = \frac{1.00}{1.00} = 1.00 \text{ ns},$$

as compared to: $t'_{(tab.)} = 2.92$ for $\alpha = 0.05$, one-tailed hypothesis, and df = 2

Table 2. Analysis of survival data for mysid shrimp, *Neomysis americana*, exposed for 96 hr to culture water control and 100% liquid phase of dredged material

Step 1. Survival Data (from Table B2)

Replicate (r)	Treatment (t):	Number of survivors: Culture water control	Number of survivors: Dredged material
1		9	2
2		10	9
3		9	4
	Mean ($\bar{x}$):	9.33 (93.3%)	5.00 (50.0%)

Step 2. Cochran's Test for Homogeneity of Variances of Survival Data

Treatment (t)	Number of survivors: Mean ($\bar{x}$)	Number of survivors: Variance(s^2)
Culture water control	9.33	0.33
Dredged material	5.00	13.00

$$C_{(cal.)} = \frac{s^2(max.)}{\Sigma s^2} = \frac{13.00}{13.33} = 0.98 \text{ ns},$$

as compared to: $C_{(tab.)} = 0.98$ for $\alpha = 0.05$, $k = 2$, and $v = 2$

Step 3. Parametric Unpaired "t" Test of Survival Data (Culture Water Control vs. Dredged Material)

$$t_{(cal.)} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\dfrac{s_1^2 + s_2^2}{3}}} = \frac{4.33}{2.11} = 2.05 \text{ ns},$$

as compared to: $t_{(tab.)} = 2.13$ for $\alpha = 0.05$, one-tailed hypothesis, and df = 4

Table 3. Analysis of survival data for Atlantic silversides, *Menidia menidia*, exposed for 96 hr to culture water control and 100% liquid phase of dredged material

Step 1. Survival Data (from Table B3)

Replicate (r)	Treatment (t):	Number of survivors: Culture water control	Number of survivors: Dredged material
1		9	10
2		9	9
3		9	9
	Mean ($\bar{x}$):	9.00 (90.0%)	9.33 (93.3%)

- - - Further Analysis Not Warranted - - -
($\bar{x}$ for dredged material greater
than $\bar{x}$ for culture water control)

($\alpha = 0.05$) in survival of mysid shrimp exposed to culture water control and 100% liquid phase of dredged material. Survival of Atlantic silversides exposed to 100% liquid phase of dredged material was greater than survival of organisms exposed to culture water control (Table 3). Therefore, visual inspection of the data is adequate to determine that no significant effect on survival of fish resulted from exposure to 100% liquid phase. These results indicate that, with regard to its toxicological effects, the liquid phase of the dredged material is environmentally acceptable for discharge to the ocean (U.S. EPA and U.S. Army COE, 1977).[1]

3.1.1.2 Suspended Particulate Phase Bioassays

Data generated by suspended particulate phase bioassays with copepods, mysid shrimp, and Atlantic silversides are presented in, respectively, Tables B4, B5, and B6 (Appendix B). Mean survival of organisms exposed for 96 hr to 100% phase was 86.7% (copepods), 60.0% (mysid shrimp), and 96.7% (Atlantic silversides).

Analyses of survival data for copepods, mysid shrimp, and Atlantic silversides exposed for 96 hr to culture water control and 100% suspended particulate phase of dredged material are presented in Tables 4-6, respectively. Mean

[1]Paragraph 28, page D13, Appendix D of the EPA and COE manual for dredged material (U.S. EPA and U.S. Army COE, 1977) specifies that "when no differences are detected between control and test survival after 96 hr, the analysis may be considered complete at this point with no indication of potential impact of the liquid (or suspended particulate) phase if the proposed disposal operation occurs." Thus, further analyses relating to LC50's and associated confidence intervals, LPC's, and environmental concentrations of the phase are not warranted.

Table 4. Analysis of survival data for copepods, *Acartia clausi*, exposed for 96 hr to culture water control and 100% suspended particulate phase of dredged material

Step 1. Survival Data (from Table B4)

Replicate (r)	Treatment (t):	Number of survivors: Culture water control	Number of survivors: Dredged material
1		9	8
2		10	9
3		10	9
	Mean ($\bar{x}$):	9.67 (96.7%)	8.67 (86.7%)

Step 2. Cochran's Test for Homogeneity of Variances of Survival Data

Treatment (t)	Number of survivors: Mean ($\bar{x}$)	Number of survivors: Variance(s^2)
Culture water control	9.67	0.33
Dredged material	8.67	0.33

$$C_{(cal.)} = \frac{s^2(\text{max.})}{\Sigma s^2} = \frac{0.33}{0.66} = 0.50 \text{ ns},$$

as compared to: $C_{(tab.)} = 0.98$ for $\alpha = 0.05$, $k = 2$, and $v = 2$

Step 3. Parametric Unpaired "t" Test of Survival Data (Culture Water Control vs. Dredged Material)

$$t_{(cal.)} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\dfrac{s_1^2 + s_2^2}{3}}} = \frac{1.00}{0.47} = 2.13 \text{ ns},$$

as compared to: $t_{(tab.)} = 2.13$ for $\alpha = 0.05$, one-tailed hypothesis, and df = 4

Table 5. Analysis of survival data for mysid shrimp, *Neomysis americana*, exposed for 96 hr to culture water control and 100% suspended particulate phase of dredged material

Step 1. Survival Data (from Table B5)

Replicate (r)	Treatment (t):	Number of survivors: Culture water control	Number of survivors: Dredged material
1		9	4
2		10	9
3		9	5
	Mean ($\bar{x}$):	9.33 (93.3%)	6.00 (60.0%)

Step 2. Cochran's Test for Homogeneity of Variances of Survival Data

Treatment (t)	Number of survivors: Mean ($\bar{x}$)	Number of survivors: Variance(s^2)
Culture water control	9.33	0.33
Dredged material	6.00	7.00

$$C_{(cal.)} = \frac{s^2(max.)}{\Sigma s^2} = \frac{7.00}{7.33} = 0.96 \text{ ns},$$

as compared to: $C_{(tab.)} = 0.98$ for $\alpha = 0.05$, $k = 2$, and $v = 2$

Step 3. Parametric Unpaired "t" Test of Survival Data (Culture Water Control vs. Dredged Material)

$$t_{(cal.)} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2 + s_2^2}{3}}} = \frac{3.33}{1.56} = 2.13 \text{ ns},$$

as compared to: $t_{(tab.)} = 2.13$ for $\alpha = 0.05$, one-tailed hypothesis, and df = 4

Table 6. Analysis of survival data for Atlantic silversides, _Menidia menidia_, exposed for 96 hr to culture water control and 100% suspended particulate phase of dredged material

Step 1. Survival Data (from Table B6)

Replicate (r)	Treatment (t):	Number of survivors: Culture water control	Number of survivors: Dredged material
1		9	10
2		9	10
3		9	9
	Mean ($\bar{x}$):	9.00 (90.0%)	9.67 (96.7%)

- - - Further Analysis Not Warranted - - -
($\bar{x}$ for dredged material greater
than $\bar{x}$ for culture water control)

survival of all species exposed to the culture water control was equal to or greater than 90%, thereby allowing further analyses of data.

Survival data for copepods and mysid shrimp indicate no statistically significant differences ($\alpha = 0.05$) in survival of organisms exposed to culture water control and 100% suspended particulate phase of dredged material (Tables 4 and 5). Survival of Atlantic silversides exposed to 100% suspended particulate phase of dredged material was greater than survival of organisms exposed to culture water control (Table 6). Consequently, it is concluded that, with regard to its toxicological effects, the suspended particulate phase of the dredged material is environmentally acceptable for oceanic discharge (U.S. EPA and U.S. Army COE, 1977).

3.1.2 Solid Phase Bioassays

Results of solid phase bioassays, unlike results of liquid and suspended particulate phase tests, are analyzed almost exclusively according to statistical techniques. The concepts of LC50s and related confidence intervals, LPCs, and models of environmental fate of discharged material are not applicable.

Data produced by solid phase bioassays with grass shrimp, hard clams, and sandworms are presented in Table B7 (Appendix B). Mean survival of organisms exposed for 10 days to dredged material was 90.0% (grass shrimp), 100.0% (hard clams), and 96.0% (sandworms).

Analysis of total (combined) survival data for the three species exposed for 10 days to control (culture) sediment, reference (disposal-site) sediment, and the solid phase of the

dredged material is presented in Table 7. Mean survival of control organisms was greater than 90%, thus allowing evaluation of data from tests with reference sediment and dredged material. These data indicate that total survival of organisms exposed to the solid phase of dredged material was greater than total survival of organisms exposed to reference sediment (95.3% versus 92.3%). Thus, it is concluded that, with regard to its toxicological effects, the solid phase of the dredged material is ecologically acceptable for discharge to the Boston Dump Site.[1]

3.2 Bioaccumulation Studies

Concentrations of Cd (Table 8), Hg (Table 9), PCBs (Table 10), and petroleum hydrocarbons (Table 11) in tissues of grass shrimp, hard clams, and sandworms that survived 10-day exposure to the solid phase of dredged material are not significantly higher ($\alpha = 0.05$) than concentrations of the chemicals in tissues of organisms exposed to reference sediment. Levels of the DDT family in tissues of all organisms exposed to the solid phase, as well as levels in tissues of reference organisms, are less than the detection limit of 0.01 μg/g wet wt.

[1]Paragraph 37, page F17, Appendix F of the EPA and COE manual for dredged material (U.S. EPA and U.S. Army COE, 1977) states that a solid phase has "real potential for causing environmentally unacceptable impacts on benthic organisms [only if] difference in mean survival between animals in the control and test sediments is statistically significant and [emphasis added] greater than 10 percent."

Table 7. Analysis of total (combined) survival data for grass shrimp (*Palaemonetes pugio*), hard clams (*Mercenaria mercenaria*), and sandworms (*Nereis virens*) exposed for 10 days to control (culture) sediment, reference (disposal-site) sediment, and solid phase of dredged material

Step 1. Total Survival Data (From Table B7)

Replicate (r)	Treatment(t):	Total number of survivors: Control (culture) sediment	Reference (disposal-site) sediment	Dredged material
1		59	56	57
2		59	58	57
3		60	55	57
4		58	53	58
5		60	55	57
	Mean ($\bar{x}$):	59.20 (98.7%)	55.40 (92.3%)	57.20 (95.3%)

- - - Further Analysis Not Warranted - - -
($\bar{x}$ for dredged material greater than $\bar{x}$ for reference sediment)

Table 8. Analyses of cadmium (Cd) in tissues of grass shrimp (Palaemonetes pugio), hard clams (Mercenaria mercenaria), and sandworms (Nereis virens) that survived 10-day exposure to reference (disposal-site) sediment and solid phase of dredged material

Organism	Analysis
Grass Shrimp	Step 1. Concentration of Metal in Tissue

Replicate (r)	Treatment (t):	Concentration (μg/g wet wt.) Reference (disposal-site) sediment	Dredged material
1		0.442	1.888
2		1.662	0.667
3		0.546	1.013
4		0.411	0.433
5		0.796	0.668
	Mean ($\bar{x}$):	0.771	0.934

Step 2. Cochran's Test for Homogeneity of Variances of Metal Data

Treatment (t)	Data (μg/g wet wt.) Mean ($\bar{x}$)	Variance(s^2)
Reference (disposal-site) sediment	0.771	0.271
Dredged material	0.934	0.327

$$C_{(cal.)} = \frac{s^2(max.)}{\Sigma s^2} = \frac{0.327}{0.598} = 0.55 \text{ ns},$$

as compared to: $C_{(tab.)} = 0.91$ for $\alpha = 0.05$, $k = 2$, and $v = 4$

Step 3. Parametric Unpaired "t" Test of Metal Data (Reference Sediment vs. Dredged Material)

$$t_{(cal.)} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2 + s_2^2}{5}}} = \frac{0.163}{0.346} = 0.47 \text{ ns},$$

as compared to: $t_{(tab.)} = 1.86$ for $\alpha = 0.05$, one-tailed hypothesis, and df = 8

Table 8. Continued

Organism	Analysis			
Hard Clams	Step 1. Concentration of Metal in Tissue			
		Treatment (t):	Concentration (µg/g wet wt.)	
	Replicate (r)		Reference (disposal-site) sediment	Dredged material
	1		0.284	0.238
	2		0.225	0.162
	3		0.213	0.169
	4		0.252	0.212
	5		0.225	0.211
		Mean ($\bar{x}$):	0.240	0.198

- - - Further Analysis Not Warranted - - -
($\bar{x}$ for dredged material less
than $\bar{x}$ for reference sediment)

Table 8. Continued

Organism	Analysis
Sandworms	Step 1. <u>Concentration of Metal in Tissue</u>

Replicate (r)	Treatment (t): Concentration (μg/g wet wt.) Reference (disposal-site) sediment	Dredged material
1	0.056	0.098
2	0.062	0.045
3	0.068	0.088
4	0.071	0.068
5	0.085	0.071
Mean ($\bar{x}$):	0.068	0.074

Step 2. <u>Cochran's Test for Homogeneity of Variances of Metal Data</u>

Treatment (t)	Data (μg/g wet wt.) Mean ($\bar{x}$)	Variance(s^2)
Reference (disposal-site) sediment	0.068	0.00012
Dredged material	0.074	0.00042

$$C_{(cal.)} = \frac{s^2(max.)}{\Sigma s^2} = \frac{0.00042}{0.00054} = 0.78 \text{ ns},$$

as compared to: $C_{(tab.)} = 0.91$ for $\alpha = 0.05$, $k = 2$, and $v = 4$

Step 3. <u>Parametric Unpaired "t" Test of Metal Data (Reference Sediment vs. Dredged Material)</u>

$$t_{(cal.)} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2 + s_2^2}{5}}} = \frac{0.006}{0.010} = 0.60 \text{ ns},$$

as compared to: $t_{(tab.)} = 1.86$ for $\alpha = 0.05$, one-tailed hypothesis, and df = 8

Table 9. Analyses of mercury (Hg) in tissues of grass shrimp (*Palaemonetes pugio*), hard clams (*Mercenaria mercenaria*), and sandworms (*Nereis virens*) that survived 10-day exposure to reference (disposal-site) sediment and solid phase of dredged material

Organism	Analysis		
Grass Shrimp	Step 1. Concentration of Metal in Tissue		
		Concentration (μg/g wet wt.)	
Replicate (r)	Treatment (t):	Reference (disposal-site) sediment	Dredged material
1		0.018	0.018
2		0.033	0.033
3		0.010	0.045
4		0.060	0.028
5		0.008	0.007
	Mean ($\bar{x}$):	0.026	0.026

- - - Further Analysis Not Warranted - - -
($\bar{x}$ for dredged material equal
to $\bar{x}$ for reference sediment)

Table 9. Continued

Organism	Analysis			
Hard Clams	Step 1. Concentration of Metal in Tissue			
		Treat-ment (t):	Concentration (μg/g wet wt.)	
	Repli-cate (r)		Reference (disposal-site) sediment	Dredged material
	1		0.007	0.007
	2		0.009	0.006
	3		0.004	0.006
	4		0.008	0.011
	5		0.005	0.006
		Mean ($\bar{x}$):	0.007	0.007

- - - Further Analysis Not Warranted - - -
($\bar{x}$ for dredged material equal
to $\bar{x}$ for reference sediment)

Table 9. Continued

Organism	Analysis			
Sandworms	Step 1. Concentration of Metal in Tissue			
		Treatment (t):	Concentration (μg/g wet wt.)	
	Replicate (r)		Reference (disposal-site) sediment	Dredged material
	1		0.001	0.001
	2		0.001	<0.001
	3		0.001	<0.001
	4		0.001	0.001
	5		0.001	0.001
		Mean ($\bar{x}$):	0.001	0.001

- - - Further Analysis Not Warranted - - -

($\bar{x}$ for dredged material equal to $\bar{x}$ for reference sediment)

Table 10. Analyses of polychlorinated biphenyls (PCBs) in tissues of grass shrimp (*Palaemonetes pugio*), hard clams (*Mercenaria mercenaria*), and sandworms (*Nereis virens*) that survived 10-day exposure to reference (disposal-site) sediment and solid phase of dredged material

Organism	Analysis			
Grass Shrimp	Step 1. Concentration of Chemicals in Tissue			
		Treatment (t):	Concentration (μg/g wet wt.)	
	Replicate (r)		Reference (disposal-site) sediment	Dredged material
	1		0.02	0.01
	2		0.02	0.02
	3		0.06	0.01
	4		0.02	0.01
	5		0.02	0.01
		Mean ($\bar{x}$):	0.03	0.01

- - - Further Analysis Not Warranted - - -
($\bar{x}$ for dredged material less
than $\bar{x}$ for reference sediment)

Table 10. Continued

Organism	Analysis
Hard Clams	Step 1. Concentration of Chemicals in Tissue

Replicate (r)	Treatment (t):	Concentration (μg/g wet wt.) Reference (disposal-site) sediment	Dredged material
1		<0.01	0.01
2		<0.01	0.02
3		<0.01	<0.01
4		<0.01	<0.01
5		<0.01	<0.01
	Mean ($\bar{x}$):	0.01	0.01

- - - Further Analysis Not Warranted - - -
($\bar{x}$ for dredged material equal
to $\bar{x}$ for reference sediment)

Table 10. Continued

Organism	Analysis		
Sandworms	Step 1. Concentration of Chemicals in Tissue		
		Concentration (μg/g wet wt.)	
	Replicate (r) / Treatment (t):	Reference (disposal-site) sediment	Dredged material
	1	0.06	0.08
	2	0.10	0.01
	3	0.08	0.01
	4	0.10	0.01
	5	0.08	0.01
	Mean ($\bar{x}$):	0.08	0.02
	- - - Further Analysis Not Warranted - - - ($\bar{x}$ for dredged material less than $\bar{x}$ for reference sediment)		

Table 11. Analyses of petroleum hydrocarbons in tissues of grass shrimp (Palaemonetes pugio), hard clams (Mercenaria mercenaria), and sandworms (Nereis virens) that survived 10-day exposure to reference (disposal-site) sediment and solid phase of dredged material

Organism	Analysis
Grass Shrimp	Step 1. Concentration of Chemicals in Tissue

Replicate (r)	Treatment (t): Reference (disposal-site) sediment — Concentration (µg/g wet wt.)	Dredged material — Concentration (µg/g wet wt.)
1	11.8	27.5
2	6.7	10.1
3	21.8	6.3
4	5.6	7.0
5	10.6	21.9
Mean ($\bar{x}$):	11.3	14.6

Step 2. Cochran's Test for Homogeneity of Variances of Chemical Data

Treatment (t)	Data (µg/g wet wt.) Mean ($\bar{x}$)	Variance(s^2)
Reference (disposal-site) sediment	11.3	41.2
Dredged material	14.6	91.6

$$C_{(cal.)} = \frac{s^2(max.)}{\Sigma s^2} = \frac{91.6}{132.8} = 0.69 \text{ ns},$$

as compared to: $C_{(tab.)} = 0.91$ for $\alpha = 0.05$, $k = 2$, and $v = 4$

Step 3. Parametric Unpaired "t" Test of Chemical Data (Reference Sediment vs. Dredged Material)

$$t_{(cal.)} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2 + s_2^2}{5}}} = \frac{3.3}{5.2} = 0.63 \text{ ns},$$

as compared to: $t_{(tab.)} = 1.86$ for $\alpha = 0.05$, one-tailed hypothesis, and df = 8

Table 11. Continued

Organism	Analysis
Hard Clams	Step 1. Concentration of Chemicals in Tissue

Replicate (r)	Treatment (t):	Concentration (µg/g wet wt.) Reference (disposal-site) sediment	Dredged material
1		1.3	1.6
2		1.2	2.0
3		1.5	2.4
4		1.4	6.3
5		1.1	2.1
	Mean ($\bar{x}$):	1.3	2.9

Step 2. Cochran's Test for Homogeneity of Variances of Chemical Data

Treatment (t)	Data (µg/g wet wt.) Mean ($\bar{x}$)	Variance(s^2)
Reference (disposal-site) sediment	1.3	0.02
Dredged material	2.9	3.74

$$C_{(cal.)} = \frac{s^2(max.)}{\Sigma s^2} = \frac{3.74}{3.76} = 0.99\ *,$$

as compared to: $C_{(tab.)} = 0.91$ for $\alpha = 0.05$, $k = 2$, and $v = 4$

Step 3. Approximate Unpaired "t" Test of Chemical Data (Reference Sediment vs. Dredged Material)

$$t'(cal.) = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2 + s_2^2}{5}}} = \frac{1.6}{0.9} = 1.78 \text{ ns},$$

as compared to: $t'_{(tab.)} = 2.13$ for $\alpha = 0.05$, one-tailed hypothesis, and df = 4

Table 11. Continued

Organism	Analysis
Sandworms	Step 1. Concentration of Chemicals in Tissue

Replicate (r)	Treatment (t):	Concentration (µg/g wet wt.) Reference (disposal-site) sediment	Dredged material
1		5.5	6.5
2		6.6	5.7
3		2.3	2.6
4		6.4	4.7
5		7.6	3.4
	Mean ($\bar{x}$):	5.7	4.6

- - - Further Analysis Not Warranted - - -
($\bar{x}$ for dredged material less
than $\bar{x}$ for reference sediment)

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APPENDIX A

LABORATORY PROCEDURES FOR PREPARING DREDGED MATERIAL AND CONDUCTING BIOASSAYS[1]

Procedure	Date of Implementation of Procedure	Certifications of Performance of Procedure: Aquatic Toxicologist	Certifications of Performance of Procedure: Laboratory Director	Certifications of Performance of Procedure: Division Director
1. Store control sediment (CS), reference sediment (RS), and 3 samples of dredged sediment (DS) at 2-4° C in separate containers. Mix sediment in each container as thoroughly as possible. Composite 3 samples of dredged sediment.	CS 11/13/80	[illegible]	[illegible]	[illegible]
	RS 11/14/80	"	"	"
	DS 11/3-11/6/80	"	"	"

Solid-phase Bioassays

Bioassays should be initiated by November 17, 1980 (2 weeks after November 3, 1980, earliest date of sediment collection). Do not be concerned with sophisticated photoperiod. Maintain dissolved oxygen in aquaria at >4 ppm. Cover aquaria to prevent salinity changes.

Procedure	Date of Implementation of Procedure	Aquatic Toxicologist	Laboratory Director	Division Director
2. Remove CS and RS from storage and wet sieve through 1-mm mesh into separate containers. Use minimum volume of artificial sea water [ASW] of salinity 30 ppt for sieving purposes. Place nonliving material remaining on sieve in appropriate containers.	11/15	"	"	"
3. Mix CS and RS in respective containers and allow to settle for 6 hr.	11/15	"	"	"
4. Decant ASW and mix CS and RS as thoroughly as possible.	11/15	"	"	"
5. Assign treatments (CS, RS, and DS) and replicates (5 r per treatment) to aquaria.	11/15	"	"	"
6. Randomly position aquaria (15) in environmental chamber maintained at 20$\pm$1°C.	11/15	"	"	"

[1]This document is a copy of the work sheet that was used during the evaluation. The document differs from the work sheet in that dates appear in typed form and certifications were added at a single time after the dates were typed.

Laboratory Procedures (Continued)

Procedure	Date of Implementation of Procedure	Certifications of Performance of Procedure		
		Aquatic Toxicologist	Laboratory Director	Division Director
14. During acclimation period, remove appropriate volumes of DS from storage and wet-sieve sample through 1-mm mesh. Use minimum volume of ASW for sieving purposes. Place nonliving material remaining on sieves in containers.	11/17	*	*	*
15. Mix DS and allow to settle for 6 hr.	11/17	*	*	*
16. Decant ASW and mix DS as thoroughly as possible.	11/17	*	*	*
17. Place 15 mm of DS in all but control and reference aquaria. Employ basic strategy identified in Step 8.	11/17	*	*	*
18. Remove remaining CS and RS from storage. Warm to test temperature ($20\pm1^{\circ}C$). Add 15 mm of CS to each control aquarium and 15 mm of RS to each reference aquarium. Employ basic strategy identified in Step 8.	11/17	*	*	*
19. Replace 75% of ASW 1 hr after addition of DS and final addition of CS and RS.	11/17	*	*	*
20. Select 300 grass shrimp from holding tank and randomly distribute into 15 culture dishes.	11/17	*	*	*

Laboratory Procedures (Continued)

Procedure	Date of Implementation of Procedure	Certifications of Performance of Procedure: Aquatic Toxicologist	Laboratory Director	Division Director
21. Randomly distribute contents of 15 culture dishes into 15 aquaria.	11/17	*	*	*
22. Perform the following activities:				
Every day after introduction of grass shrimp into aquaria				
• Record salinity, temperature, dissolved oxygen, and pH in each aquarium (record in log book) • Record obvious mortality, formation of tubes or burrows, and unusual behavior patterns of animals (record in log book)	Day 0 11/17	*	*	*
	Day 1 11/18	*	*	*
	Day 2 11/19	*	*	*
	Day 3 11/20	*	*	*
	Day 4 11/21	*	*	*
	Day 5 11/22	*	*	*
	Day 6 11/23	*	*	*
	Day 7 11/24	*	*	*
	Day 8 11/25	*	*	*
	Day 9 11/26	*	*	*
	Day 10 11/27	*	*	*
Every 2 days after introduction of grass shrimp into aquaria				
• Replace 75% of ASW	Day 2 11/19	*	*	*
	Day 4 11/21	*	*	*
	Day 6 11/23	*	*	*
	Day 8 11/25	*	*	*
23. At end of 10-day testing period, sieve sediment in each aquarium through 0.5-mm screen. Count live animals. Note sublethal responses. Depurate surviving organisms in ASW for 48 hr and preserve for bioaccumulation study.	11/27	*	*	*

Laboratory Procedures (Continued)

Procedure	Date of Implementation of Procedure	Certifications of Performance of Procedure: Aquatic Toxicologist	Laboratory Director	Division Director

<u>Suspended-Particulate-Phase Bioassays</u>

Bioassays should be initiated by November 17, 1980 (2 weeks after November 3, 1980, earliest date of dredged-sediment collection). Maintain 14-hr light photoperiod with cool-white fluorescent bulbs mounted approximately 0.5-1 m above tops of aquaria. Maintain dissolved oxygen in aquaria at >4 ppm. Cover aquaria to prevent salinity changes.

Procedure	Date of Implementation of Procedure	Aquatic Toxicologist	Laboratory Director	Division Director
24. Prepare suspended-particulate-phase sample. Follow procedures in Appendix B of EPA/COE Implementation Manual. In particular:				
• Clean laboratory glassware thoroughly	11/10-11/14	*	*	*
• Remove from storage appropriate volumes of DS. Mix sample as thoroughly as possible. Combine with ASW in 1:4 ratio by volume. Shake on automatic shaker for 30 min at 100 oscillations/min. Do not allow dissolved oxygen to reach zero. Settle for 1 hr. Collect supernatant.	Copepod 11/14	*	*	*
	Mysid shrimp 11/14	*	*	*
	Silverside 11/17	*	*	*
25. Begin suspended-particulate-phase bioassays as soon as sufficient suspended particulate phase is prepared. Store initial volumes of suspended particulate phase at 2-4°C. Combine all volumes prior to use in bioassays.	Copepod 11/14	*	*	*
	Mysid shrimp 11/14	*	*	*
	Silverside 11/17	*	*	*
26. For each species tested (copepod, mysid shrimp, and Atlantic silverside), assign treatments (culture-water control [100% ASW]; 10%, 50%, 100% suspended-particulate phase of DS) and replicates (3 r per treatment) to aquaria/culture dishes.	Copepod 11/14	*	*	*
	Mysid shrimp 11/14	*	*	*
	Silverside 11/17	*	*	*

Laboratory Procedures (Continued)

Procedure		Date of Implementation of Procedure	Certifications of Performance of Procedure: Aquatic Toxicologist	Laboratory Director	Division Director
27. For each species tested, randomly position aquaria/culture dishes in environmental chamber maintained at 20±1°C.		Copepod 11/14	*	*	*
		Mysid shrimp 11/14	*	*	*
		Silverside 11/17	*	*	*
28. Establish appropriate concentrations of control water and suspended particulate phase of DS in aquaria/culture dishes.		Copepod 11/14	*	*	*
		Mysid shrimp 11/14	*	*	*
		Silverside 11/17	*	*	*
29. Randomly distribute 10 individuals of test species into each aquarium/culture dish. Cover aquaria/dishes.		Copepod 11/14	*	*	*
		Mysid shrimp 11/14	*	*	*
		Silverside 11/17	*	*	*
30. Monitor the following variables:					
At start and end of 96-hr testing period					
• Salinity, temperature, dissolved oxygen, and pH in each aquarium/culture dish (record in log book).	Start of test (0 hr)	Copepod 11/14	*	*	*
		Mysid shrimp 11/14	*	*	*
		Silverside 11/17	*	*	*
	End of test (96 hr)	Copepod 11/18	*	*	*
		Mysid shrimp 11/18	*	*	*
		Silverside 11/21	*	*	*
During 96-hr testing period					
• Survival (record in log book)	Start of test (0 hr)	X	*	*	*
	4 hr	X	*	*	*
	8 hr	X	*	*	*
	24 hr	X	*	*	*
	48 hr	X	*	*	*
	72 hr	X	*	*	*
	End of test (96 hr)	X	*	*	*

Laboratory Procedures (Continued)

Procedure	Date of Implementation of Procedure	Certifications of Performance of Procedure: Aquatic Toxicologist	Laboratory Director	Division Director

Liquid-Phase Bioassays

Bioassays should be initiated by November 17, 1980 (2 weeks after November 3, 1980, earliest date of dredged-sediment collection). Maintain 14-hr light photoperiod with cool-white fluorescent bulbs mounted approximately 0.5-1 m above tops of aquaria. Maintain dissolved oxygen in aquaria at >4 ppm. Cover aquaria to prevent salinity changes.

Procedure	Date of Implementation of Procedure	Aquatic Toxicologist	Laboratory Director	Division Director
31. Prepare liquid-phase sample. Follow procedures in Appendix B of EPA/COE Implementation Manual. In particular:				
• Clean laboratory glassware, filtration equipment, and filters (0.45 u).	11/10-11/14	*	*	*
• Remove from storage appropriate volumes of DS. Mix sample as thoroughly as possible. Combine with ASW in 1:4 ratio by volume. Shake on automatic shaker for 30 min at 100 oscillations/min. Do not allow dissolved oxygen to reach zero. Settle for 1 hr. Collect supernatant and filter (centrifugation may be employed if needed to expedite filtration process). Discard first 50 ml of filtrate passed through each filter. Collect remainder of filtrate.	Copepod 11/14	*	*	*
	Mysid shrimp 11/14	*	*	*
	Silverside 11/17	*	*	*
32. Begin liquid phase bioassays as soon as sufficient liquid phase is prepared. Store initial volumes of liquid phase at 2-4°C. Combine all volumes prior to use in bioassays.	Copepod 11/14	*	*	*
	Mysid shrimp 11/14	*	*	*
	Silverside 11/17	*	*	*
33. For each species tested (copepod, mysid shrimp, and Atlantic silverside), assign treatments (culture-water control [100% ASW]; 10%, 50%, 100% liquid phase of DS) and replicates (3 r per treatment) to aquaria/culture dishes.	Copepod 11/14	*	*	*
	Mysid shrimp 11/14	*	*	*
	Silverside 11/17	*	*	*

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Laboratory Procedures (Continued)

Procedure		Date of Implementation of Procedure	Certifications of Performance of Procedure: Aquatic Toxicologist	Laboratory Director	Division Director
34. For each species tested, randomly position aquaria/culture dishes in environmental chamber maintained at 20+1°C.		Copepod 11/14	*	*	*
		Mysid shrimp 11/14	*	*	*
		Silverside 11/17	*	*	*
35. Establish appropriate concentrations of control water and liquid phase of DS in aquaria/culture dishes.		Copepod 11/14	*	*	*
		Mysid shrimp 11/14	*	*	*
		Silverside 11/17	*	*	*
36. Randomly distribute 10 individuals of test species into each aquarium/culture dish. Cover aquaria/dishes.		Copepod 11/14	*	*	*
		Mysid shrimp 11/14	*	*	*
		Silverside 11/17	*	*	*
37. Monitor the following variables:					
At start and end of 96-hr testing period					
● Salinity, temperature, dissolved oxygen, and pH in each aquarium/culture dish (record in log book).	Start of test (0 hr)	Copepod 11/14	*	*	*
		Mysid shrimp 11/14	*	*	*
		Silverside 11/17	*	*	*
	End of test (96 hr)	Copepod 11/18	*	*	*
		Mysid shrimp 11/18	*	*	*
		Silverside 11/21	*	*	*
During 96-hr testing period					
● Survival (record in log book)	Start of test (0 hr)	X	*	*	*
	4 hr	X	*	*	*
	8 hr	X	*	*	*
	24 hr	X	*	*	*
	48 hr	X	*	*	*
	72 hr	X	*	*	*
	End of test (96 hr)	X	*	*	*

APPENDIX B

Raw bioassay-related data are presented according to the following sequence - liquid phase bioassays, suspended particulate phase bioassays, and solid phase bioassays.

B.1 Liquid Phase Bioassays

Table B1. Results of liquid phase bioassay with copepods, *Acartia clausi*[a]

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
<u>Culture water control</u>								
	1	10	10	10	10	10	10	9
	2	10	10	10	10	10	9	9
	3	10	10	10	10	9	9	9
	Mean ($\bar{x}$):							9.00 (90.0%)
<u>10% liquid phase of dredged material</u>								
	1	10	10	10	10	9	9	8
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	9	7
<u>50% liquid phase of dredged material</u>								
	1	10	10	10	10	9	7	7
	2	10	10	10	10	9	9	9
	3	10	10	10	10	8	8	7
<u>100% liquid phase of dredged material</u>								
	1	10	10	10	10	10	10	9
	2	10	10	10	10	10	10	9
	3	10	10	10	10	8	8	6
	Mean ($\bar{x}$):							8.00 (80.0%)

[a]Bioassays were conducted at 20 ± 1°C in 100-ml culture dishes. A 14-hr light (~1200 μw/cm^2 at surface of dishes) and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Test media were not aerated. Dissolved oxygen concentrations in the media ranged from 5.9-7.1 mg/l at the start of the bioassays to 7.0-7.3 mg/l at the end of the tests. pH varied from 7.6-7.8 (start of bioassays) to 7.6-7.8 (end of bioassays). Salinity was maintained at 30 ppt.

Table B2. Results of liquid phase bioassay with mysid shrimp, *Neomysis americana*[a]

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors 0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
Culture water control								
	1	10	10	10	10	9	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	9	9	9
	Mean ($\bar{x}$):							9.33 (93.3%)
10% liquid phase of dredged material								
	1	10	10	10	9	7	6	5
	2	10	10	10	9	9	8	7
	3	10	10	10	10	8	6	6
50% liquid phase of dredged material								
	1	10	10	10	9	9	7	6
	2	10	10	10	9	7	7	7
	3	10	10	10	10	9	8	8
100% liquid phase of dredged material								
	1	10	10	10	10	6	3	2
	2	10	10	10	10	10	9	9
	3	10	10	10	8	6	4	4
	Mean ($\bar{x}$):							5.00 (50.0%)

[a]Bioassays were conducted at 20±1°C in 1000-ml culture dishes. Animals were fed live 48-hr-old *Artemia* (brine shrimp) nauplii at a rate of ~1 ml of culture/dish/day. A 14-hr light (~1200 μw/cm^2 at surface of dishes) and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Test media were not aerated. Dissolved oxygen concentrations in the media ranged from 6.5-7.6 mg/l at the start of the bioassays to 6.3-7.1 mg/l at the end of the tests. pH varied from 7.7-8.1 (start of bioassays) to 7.6-7.7 (end of bioassays). Salinity was maintained at 30 ppt.

Table B3. Results of liquid phase bioassay with Atlantic silversides, *Menidia menidia*[a]

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors 0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
Culture water control								
	1	10	10	10	10	9	9	9
	2	10	10	10	10	9	9	9
	3	10	10	10	10	9	9	9
	Mean ($\bar{x}$):							9.00 (90.0%)
10% liquid phase of dredged material								
	1	10	10	10	10	10	10	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
50% liquid phase of dredged material								
	1	10	10	10	10	[illegible]	9	9
	2	10	10	10	10	10	10	9
	3	10	10	10	10	10	10	10
100% liquid phase of dredged material								
	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	9	9
	3	10	10	10	10	9	9	9
	Mean ($\bar{x}$):							9.33 (93.3%)

[a] Bioassays were conducted at 20±1°C in 19-liter aquaria. A 14-hr light (~1200 μw/cm^2 at surface of aquaria) and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Test media were not aerated. Dissolved oxygen concentrations in the media ranged from 7.3-7.7 mg/l at the start of the bioassays to 5.2-5.8 mg/l at the end of the tests. pH varied from 7.5-7.6 (start of bioassays) to 7.4-7.6 (end of bioassays). Salinity was maintained at 30 ppt.

B.2 Suspended Particulate Phase Bioassays

Table B4. Results of suspended particulate phase bioassay with copepods, *Acartia clausi*[a]

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
Culture water control								
	1	10	10	10	10	9	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10
	Mean ($\bar{x}$):							9.67 (96.7%)
10% suspended particulate phase of dredged material								
	1	10	10	10	10	8	8	8
	2	10	10	10	10	10	10	9
	3	10	10	10	10	9	9	9
50% suspended particulate phase of dredged material								
	1	10	10	10	10	9	9	8
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	9	9
100% suspended particulate phase of dredged material								
	1	10	10	10	10	10	10	8
	2	10	10	10	10	9	9	9
	3	10	10	10	10	10	9	9
	Mean ($\bar{x}$):							8.67 (86.7%)

[a]Bioassays were conducted at 20 ± 1°C in 100-ml culture dishes. A 14-hr light (~1200 μw/cm^2 at surface of dishes) and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Test media were not aerated. Dissolved oxygen concentrations in the media ranged from 7.6-8.3 mg/l at the start of the bioassays to 7.0-7.5 mg/l at the end of the tests. pH varied from 8.0-8.2 (start of bioassays) to 7.9-8.2 (end of bioassays). Salinity was maintained at 30 ppt.

Table B5. Results of suspended particulate phase bioassay with mysid shrimp, *Neomysis americana*[a]

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
Culture water control								
	1	10	10	10	10	9	9	9
	2	10	10	10	10	10	10	10
	3	10	10	10	10	9	9	9
	Mean ($\bar{x}$):							9.33 (93.3%)
10% suspended particulate phase of dredged material								
	1	10	10	10	10	8	6	5
	2	10	10	10	9	7	5	5
	3	10	10	10	9	7	7	6
50% suspended particulate phase of dredged material								
	1	10	10	10	9	7	7	6
	2	10	10	10	9	9	9	7
	3	10	10	10	10	8	7	5
100% suspended particulate phase of dredged material								
	1	10	10	10	9	7	5	4
	2	10	10	10	9	9	9	9
	3	10	10	10	10	9	8	5
	Mean ($\bar{x}$):							6.00 (60.0%)

[a]Bioassays were conducted at 20±1°C in 1000-ml culture dishes. Animals were fed live 48-hr-old *Artemia* (brine shrimp) nauplii at a rate of ~1 ml of culture/dish/day. A 14-hr light (~1200 μw/cm^2 at surface of dishes) and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Test media were not aerated. Dissolved oxygen concentrations in the media ranged from 6.9-7.5 mg/l at the start of the bioassays to 6.8-7.1 mg/l at the end of the tests. pH varied from 7.7-8.1 (start of bioassays) to 7.6-7.7 (end of bioassays). Salinity was maintained at 30 ppt.

Table B6. Results of suspended particulate phase bioassay with Atlantic silversides, *Menidia menidia*[a]

Treatment (Exposure Condition)	Replicate (r)	Number of Survivors						
		0 hr	4 hr	8 hr	24 hr	48 hr	72 hr	96 hr
Culture water control								
	1	10	10	10	10	9	9	9
	2	10	10	10	10	9	9	9
	3	10	10	10	10	9	9	9
	Mean ($\bar{x}$):							9.00 (90.0%)
10% suspended particulate phase of dredged material								
	1	10	10	10	9	9	9	8
	2	10	10	10	10	10	8	8
	3	10	10	10	10	10	10	10
50% suspended particulate phase of dredged material								
	1	10	10	10	10	10	8	8
	2	10	10	10	10	10	10	10
	3	10	10	10	10	9	9	9
100% suspended particulate phase of dredged material								
	1	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	9
	Mean ($\bar{x}$):							9.67 (96.7%)

[a] Bioassays were conducted at 20±1°C in 19-liter aquaria. A 14-hr light (~1200 μw/cm²) at surface of aquaria) and 10-hr dark photoperiod was maintained with cool-white fluorescent bulbs. Test media were not aerated. Dissolved oxygen concentrations in the media ranged from 6.5-7.6 mg/l at the start of the bioassays to 5.0-5.7 mg/l at the end of the tests. pH varied from 7.2-7.9 (start of bioassays) to 7.4-7.6 (end of bioassays). Salinity was maintained at 30 ppt.

B.3 Solid Phase Bioassays

Table B7. Results of solid phase bioassays with grass shrimp (*Palaemonetes pugio*), hard clams (*Mercenaria mercenaria*), and sandworms (*Nereis virens*)[a]

Treatment (t):	Number of Survivors[b,c]											
	Control (Culture) Sediment				Reference (Disposal-Site) Sediment				Dredged Material			
Replicate (r)	Grass Shrimp	Hard Clams	Sand-worms	Total	Grass Shrimp	Hard Clams	Sand-worms	Total	Grass Shrimp	Hard Clams	Sand-worms	Total
1	20	20	19	59	16	20	20	56	19	20	18	57
2	19	20	20	59	18	20	20	58	17	20	20	57
3	20	20	20	60	18	20	17	55	17	20	20	57
4	20	20	18	58	15	20	18	53	20	20	18	58
5	20	20	20	60	19	20	16	55	17	20	20	57
Mean ($\bar{x}$)	19.80	20.00	19.40	59.20	17.20	20.00	18.20	55.40	18.00	20.00	19.20	57.20
(%)	(99.0)	(100.0)	(97.0)	(98.7)	(86.0)	(100.0)	(91.0)	(92.3)	(90.0)	(100.0)	(96.0)	(95.3)

[a]Bioassays (10-day tests) were conducted at 20±1° C in 38-liter aquaria. Organisms were exposed to each replicate of a treatment in a single aquarium. Water in aquaria was exchanged by the replacement, as compared to the flow-through, method and was aerated. A 14-hour light and 10 hr dark photoperiod was maintained with cool-white fluorescent bulbs. Minimum values of dissolved oxygen and pH recorded during the bioassays were 4.0 mg/l and 6.9, respectively. Salinity was maintained at 30 ppt.

[b]Twenty (20) individuals of each species were initially exposed to each replicate of a treatment. Thus, a total of 60 animals was employed in each aquarium.

[c]In addition to monitoring survival of all species, burrowing behavior of sandworms was noted at 2-day intervals. No differences were observed among aquaria.

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